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Saeki et al.

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(54) **TORQUE FLUCTUATION ABSORBING APPARATUS**

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Oct. 8, 2010 (JP) 2010-228722

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F16D 7/02 (2006.01)

(52) **U.S. Cl.** .... **464/46**; 192/107 C

(58) **Field of Classification Search** .... 464/45–48; 192/107 C

See application file for complete search history.

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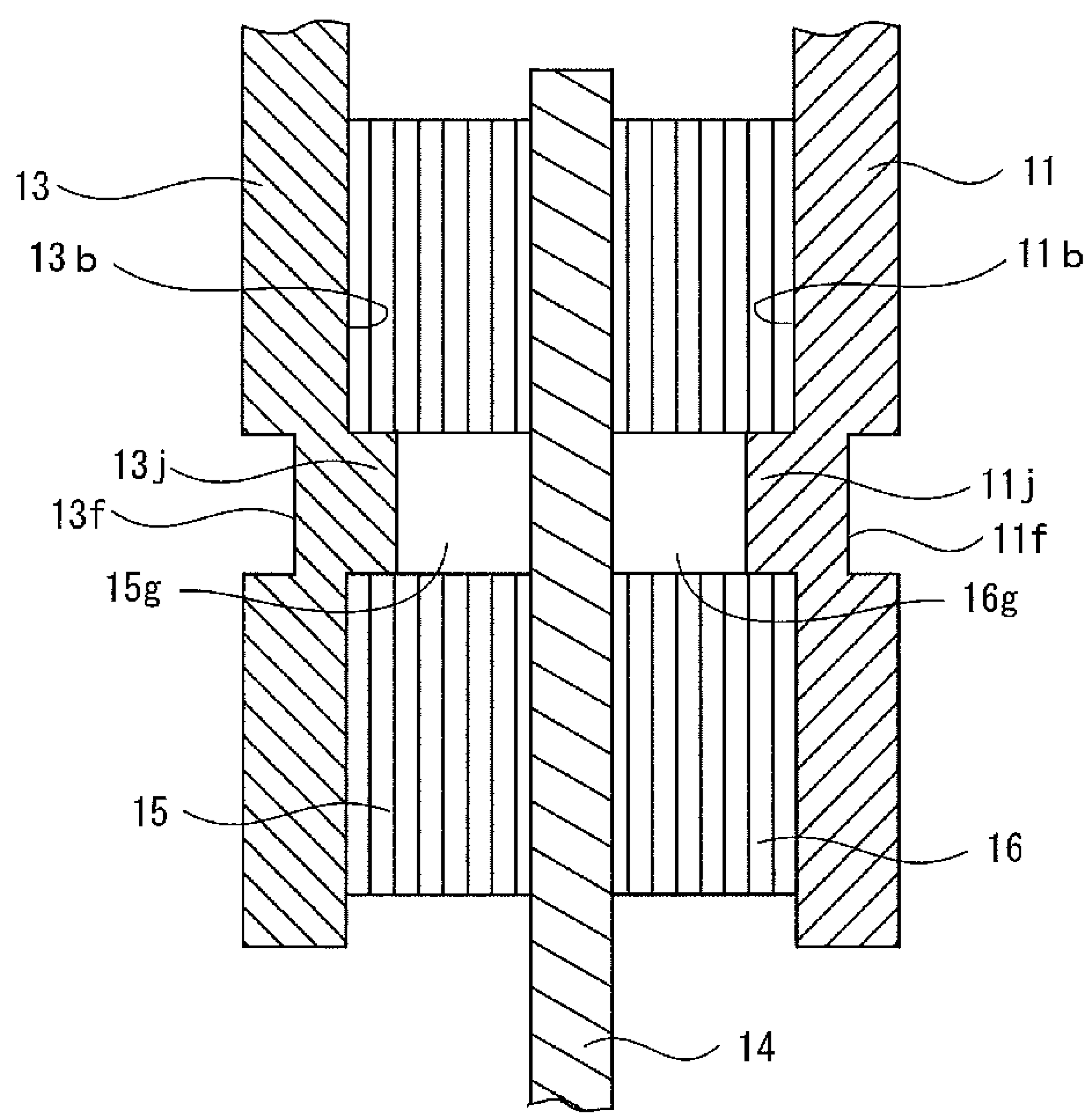
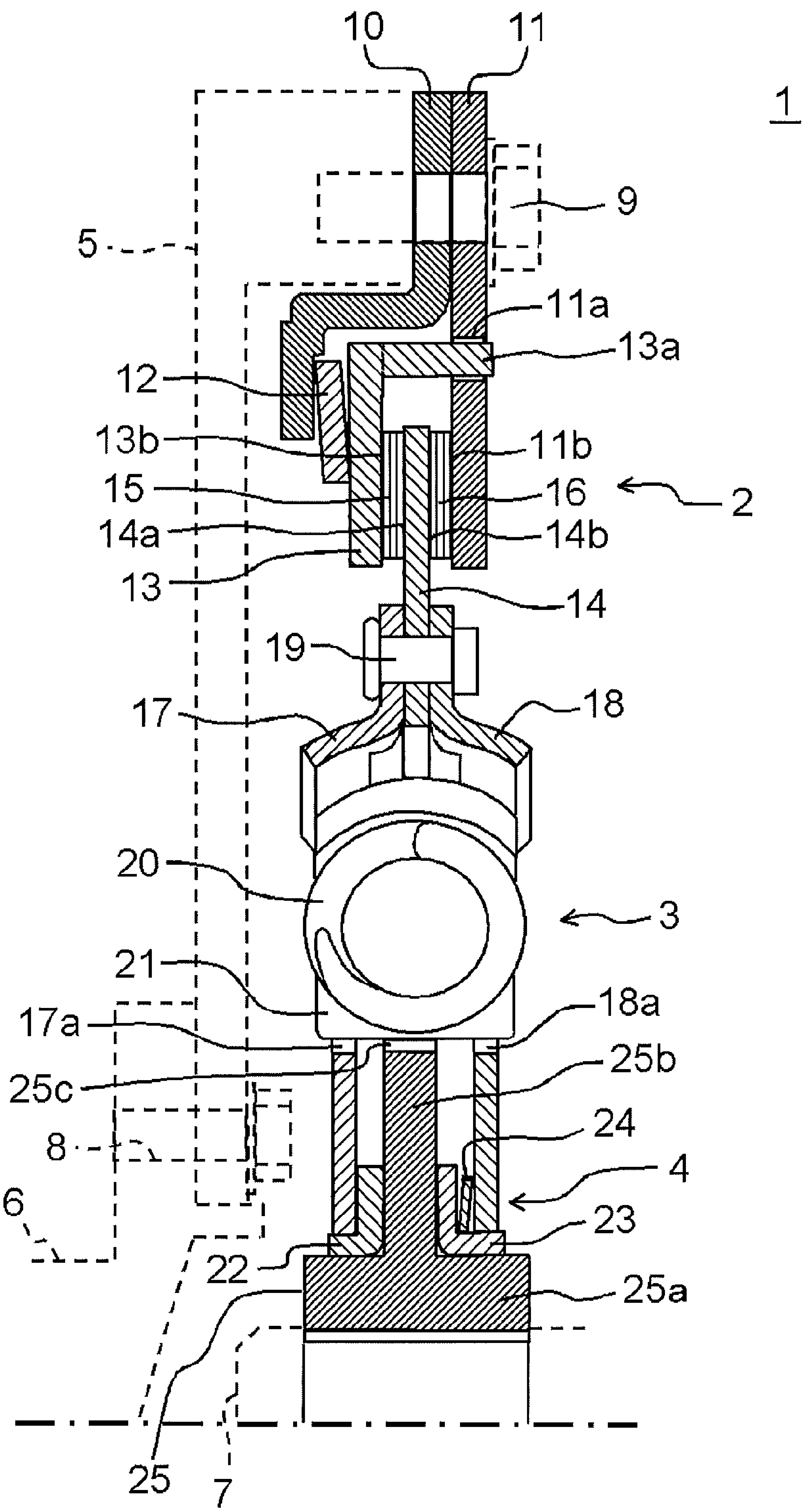
(57) **ABSTRACT**

A torque fluctuation absorbing apparatus includes a first plate member, a second plate member rotatable relative to the first plate member, and a first friction member disposed between the first plate member and the second plate member and pressed against the first plate member in a slidable manner. The second plate member includes a first retaining surface that makes contact with the first friction member. The first friction member includes a plurality of grooves at a surface facing the first retaining surface of the second plate member, the grooves extending in a radial direction of the first friction member.

4 Claims, 13 Drawing Sheets



F I G. 1


10
11
1
9
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11a
13a
12
13b
11b
2
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14a
14b
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19
17
18
20
3
21
18a
17a
25b
25c
24
8
4
6
23
22
25a
25
7

FIG. 2A

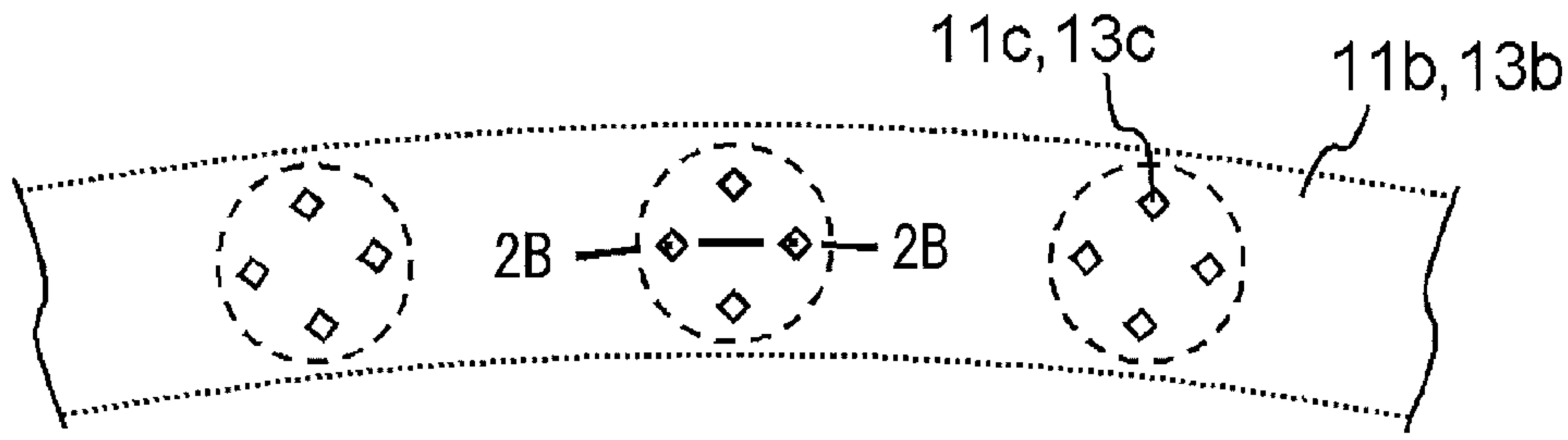


FIG. 2B

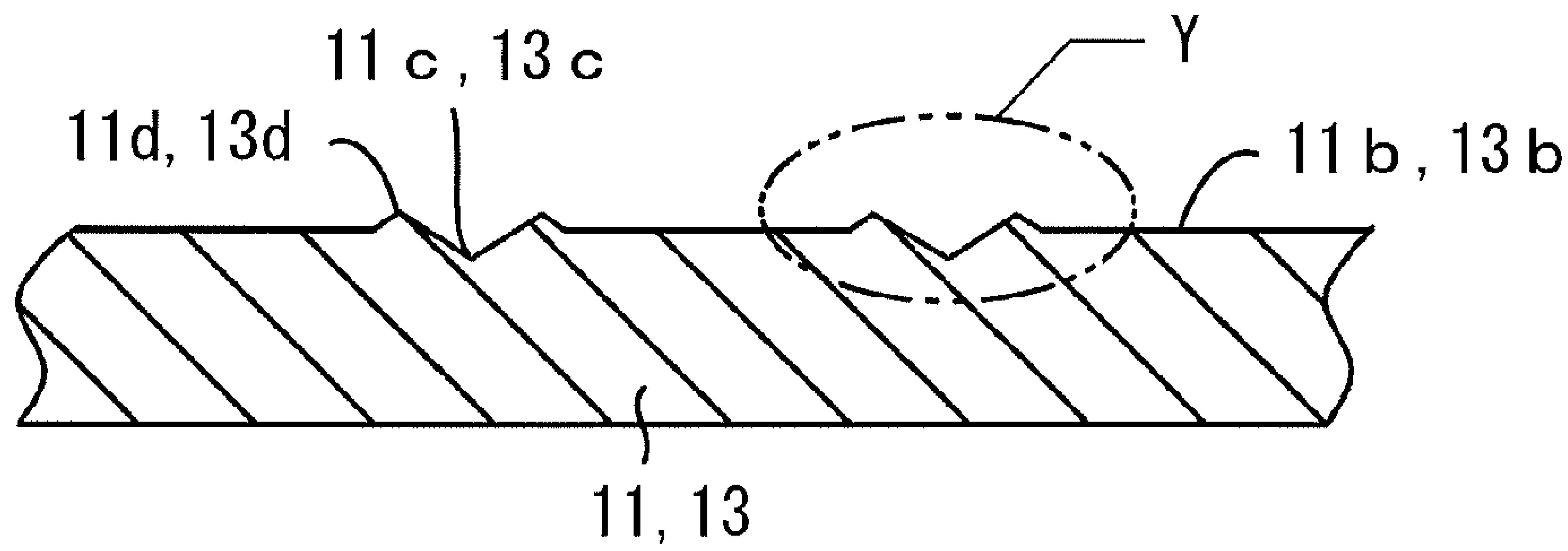


FIG. 2C

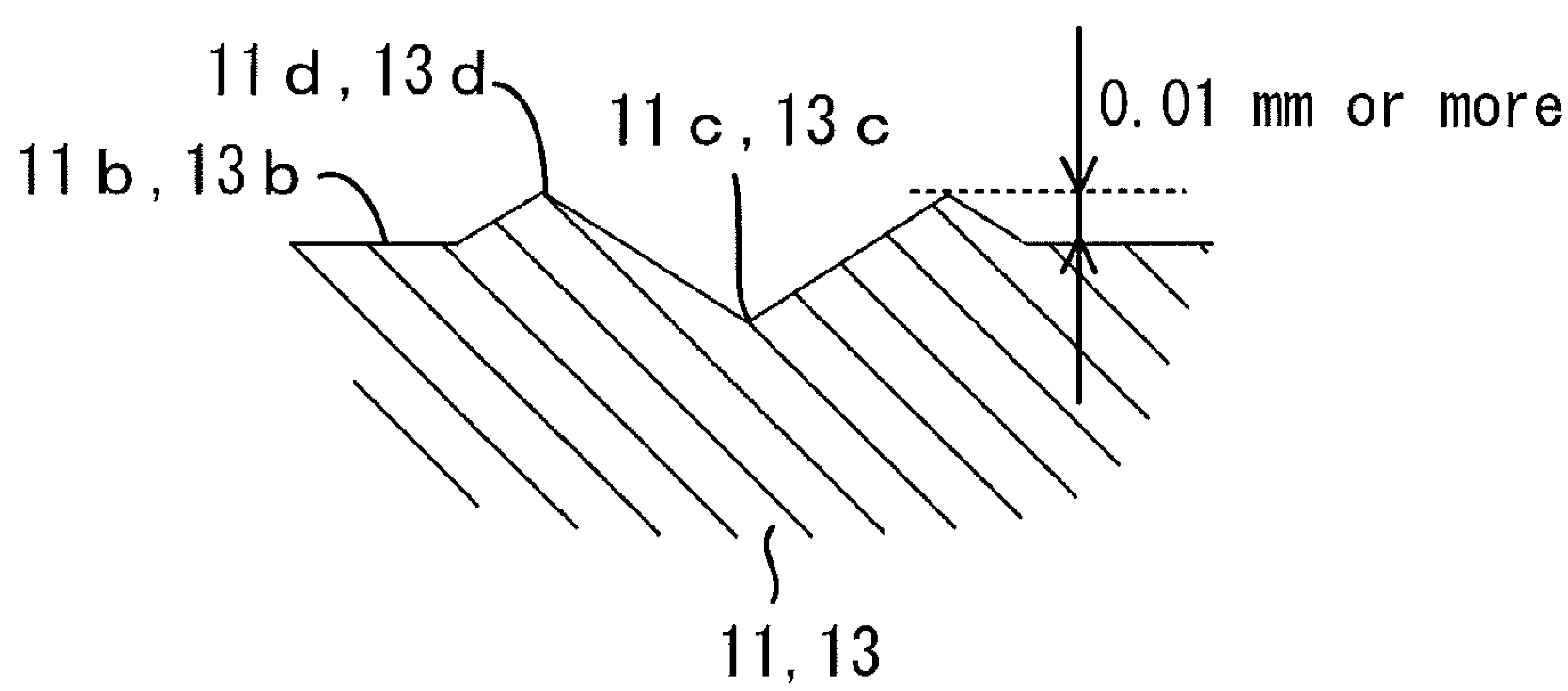


FIG. 3A

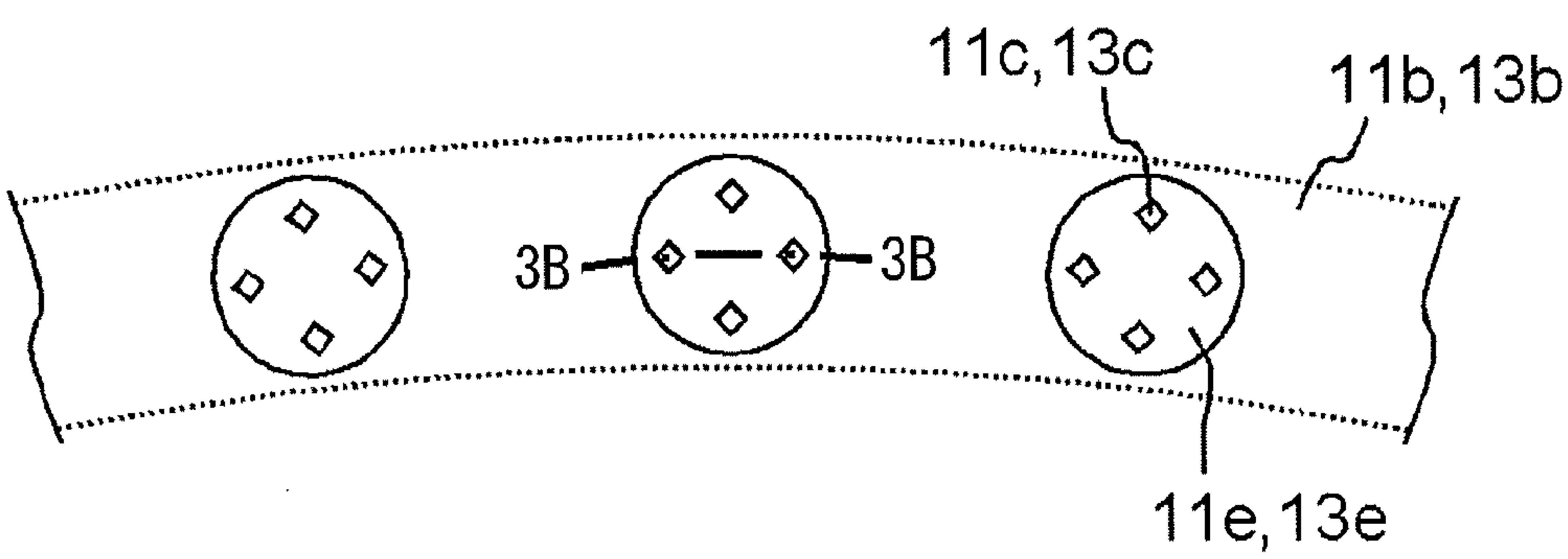
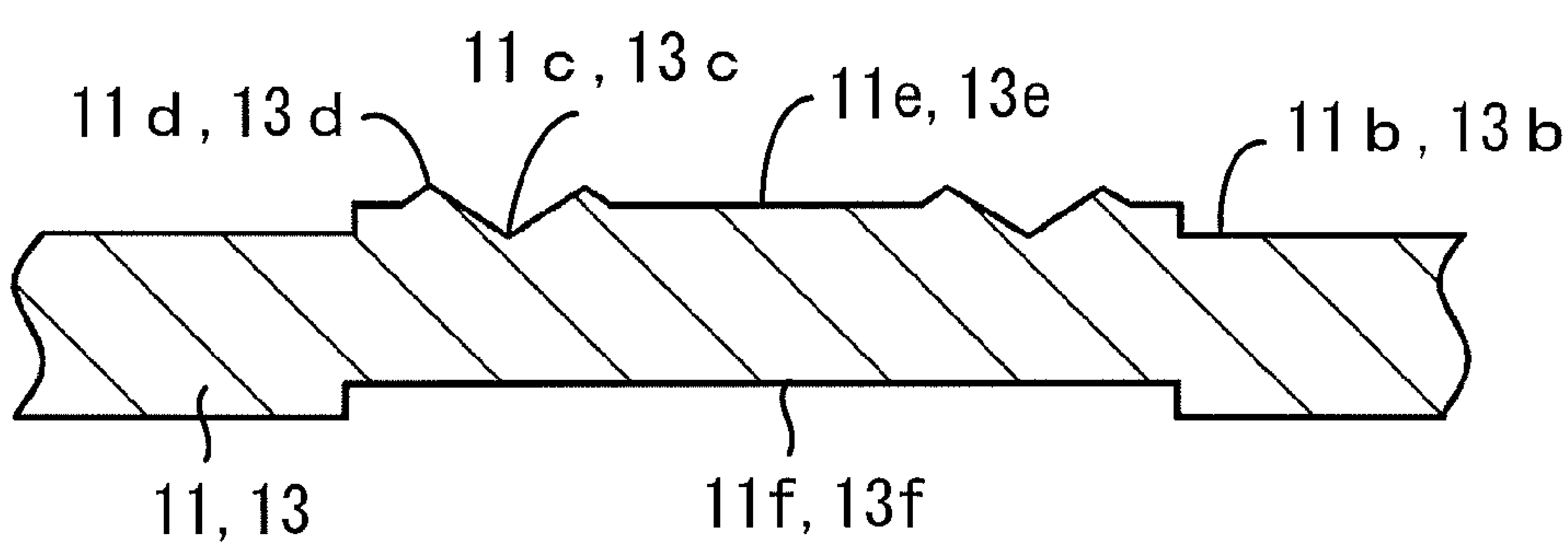
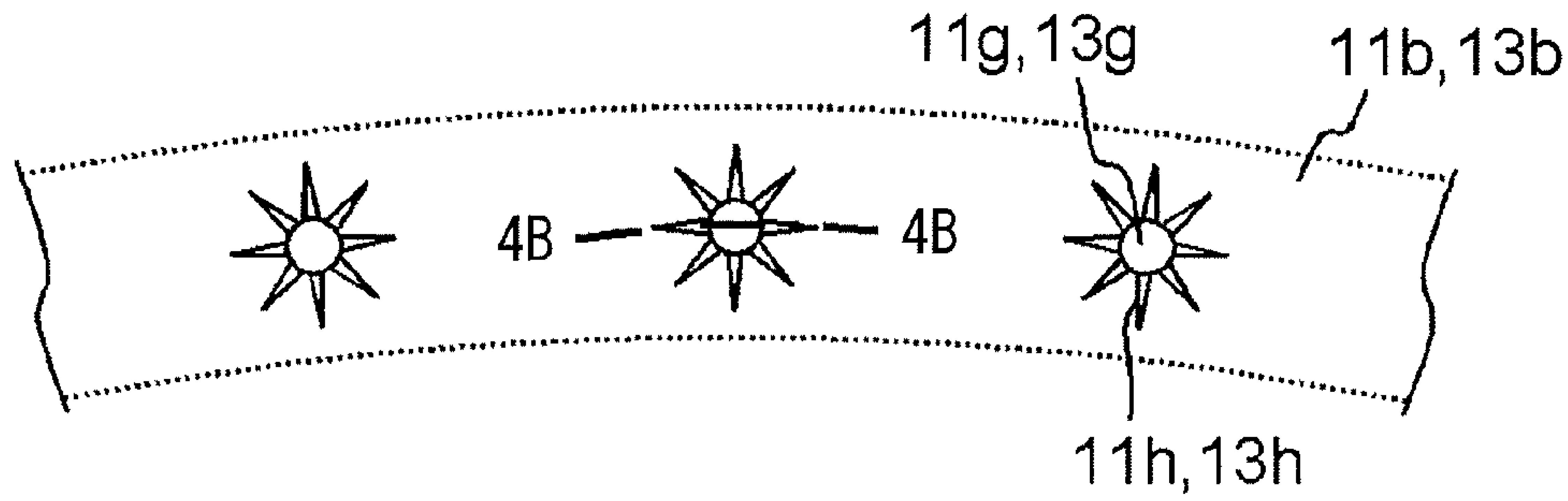

11c,13c
11b,13b
3B
3B
11e,13e

FIG. 3B


11 c , 13 c
11 d , 13 d
11e, 13e
11 b , 13 b
11, 13
11f, 13f

F I G. 4 A



F I G. 4 B

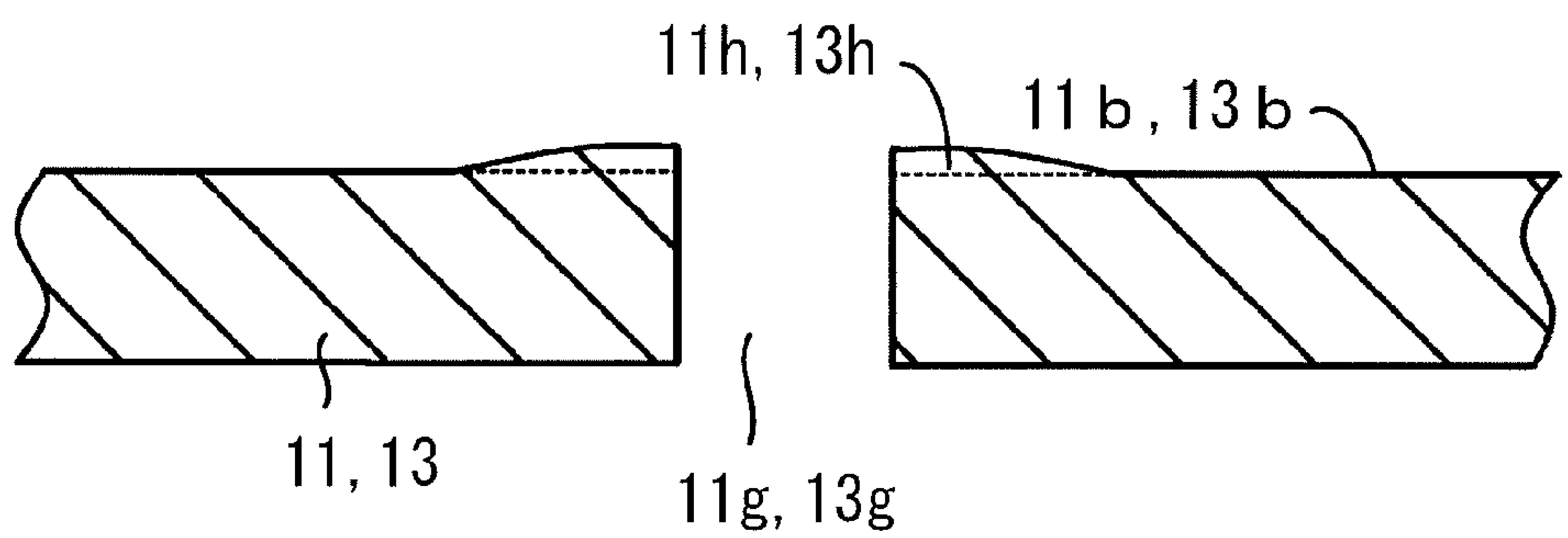


FIG. 5A Knurling (single type)

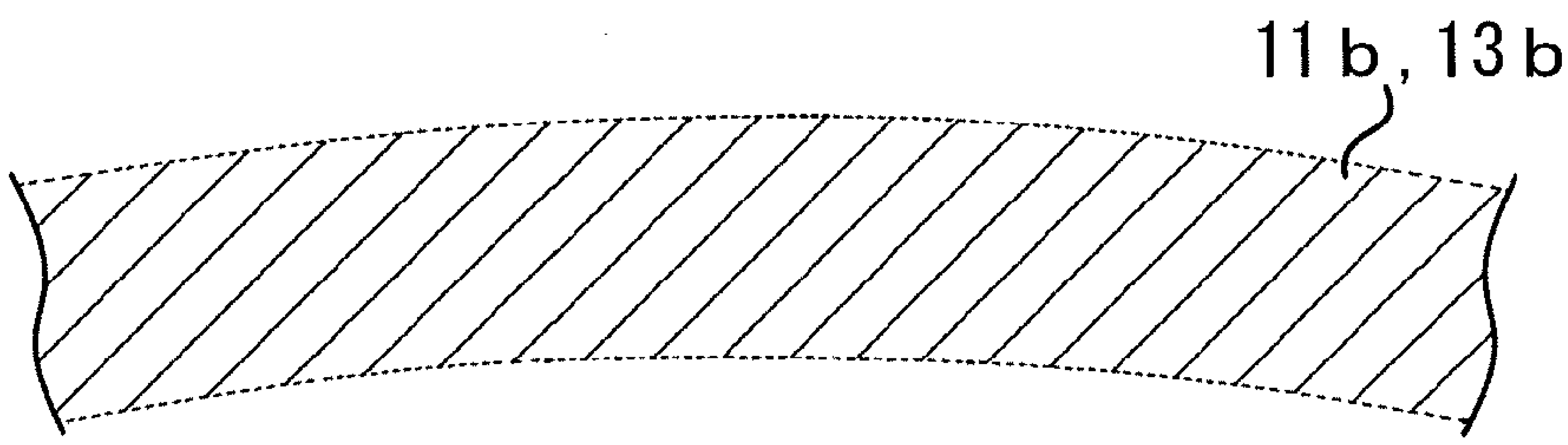


FIG. 5B Knurling (cross type)

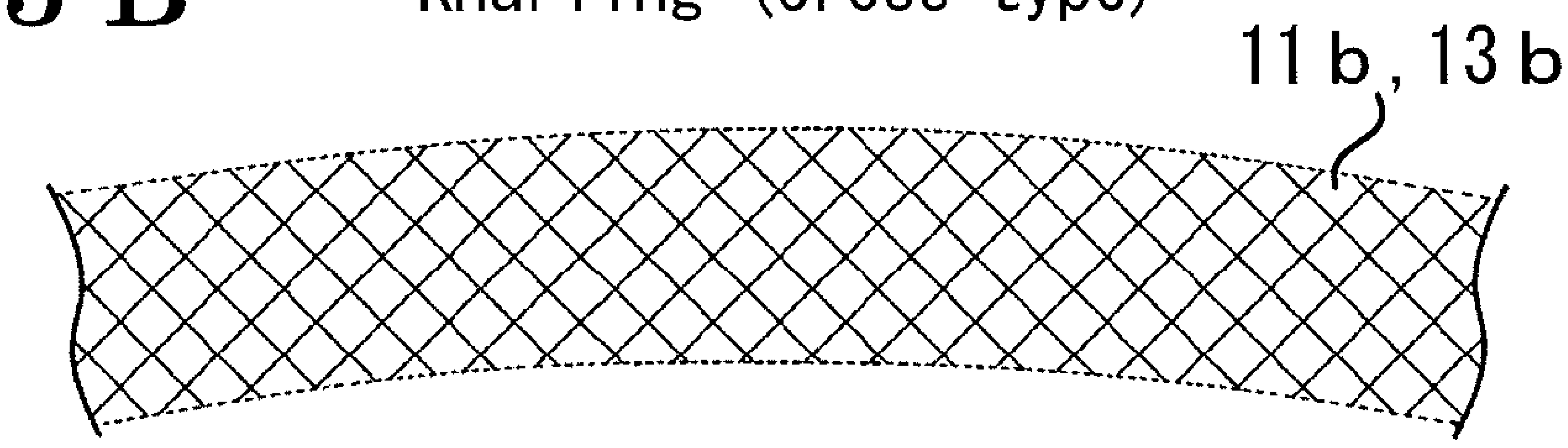


FIG. 5C Cross section

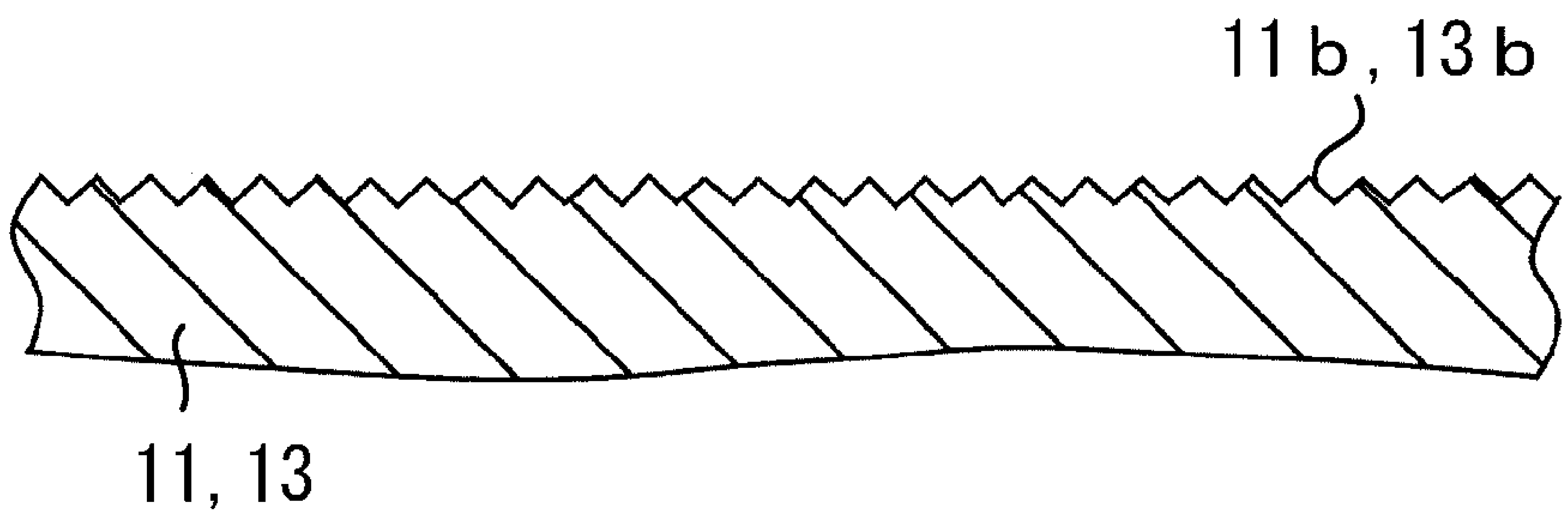


FIG. 6A

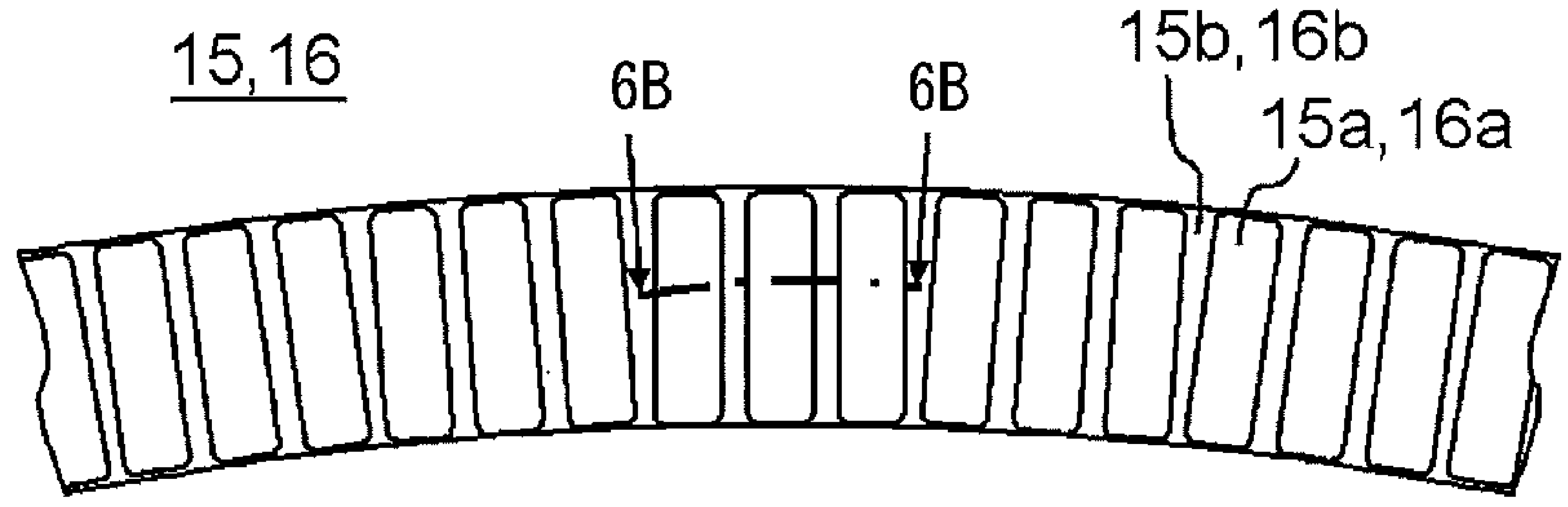
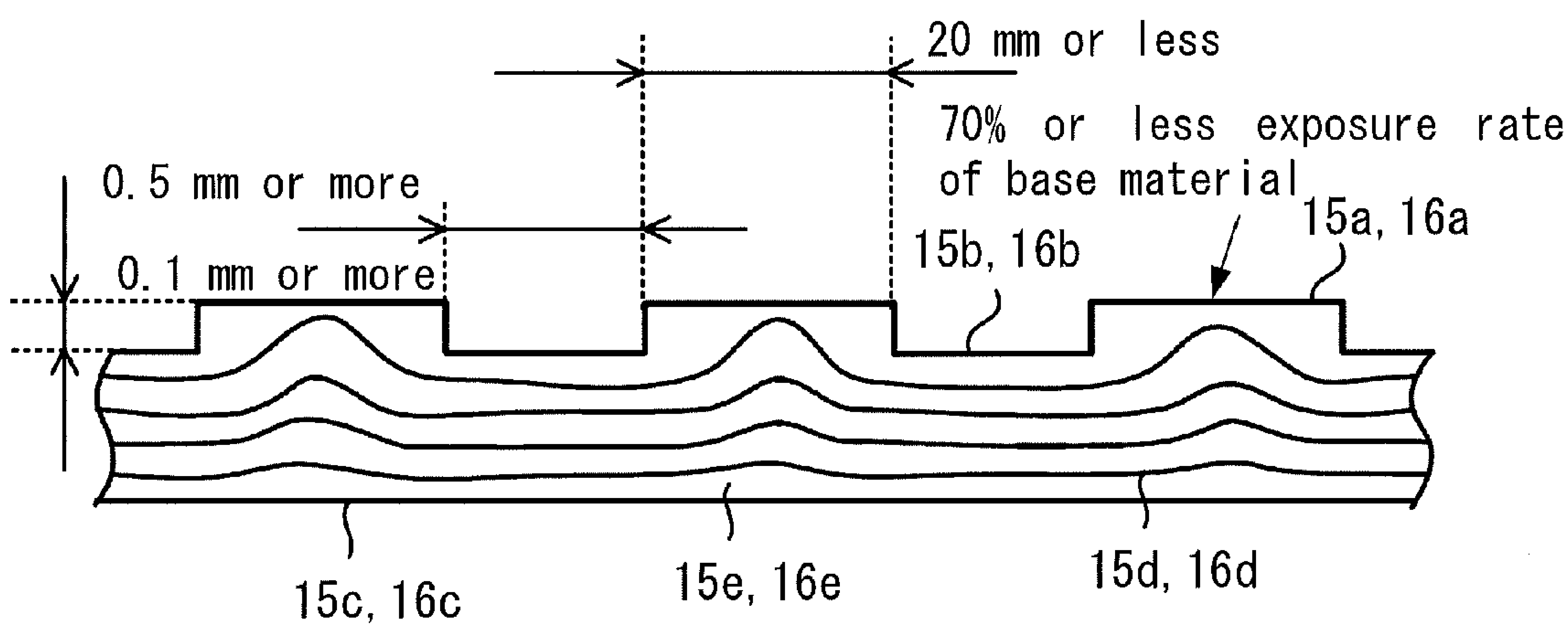

15,16
6B
6B
15b, 16b
15a, 16a

FIG. 6B


20 mm or less
70% or less exposure rate of base material
0.5 mm or more
0.1 mm or more
15b, 16b
15a, 16a
15c, 16c
15e, 16e
15d, 16d

F I G. 7

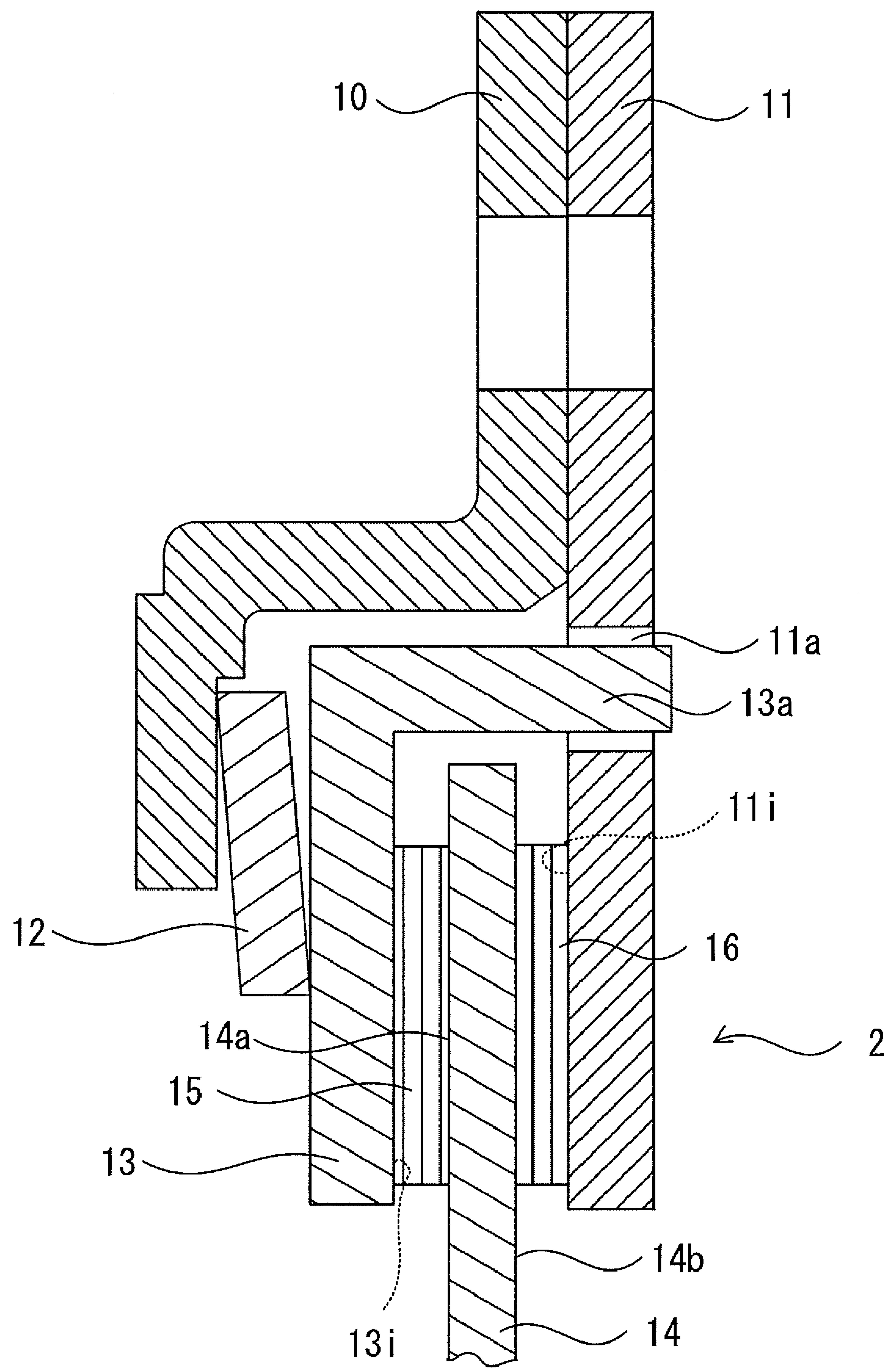


FIG. 8

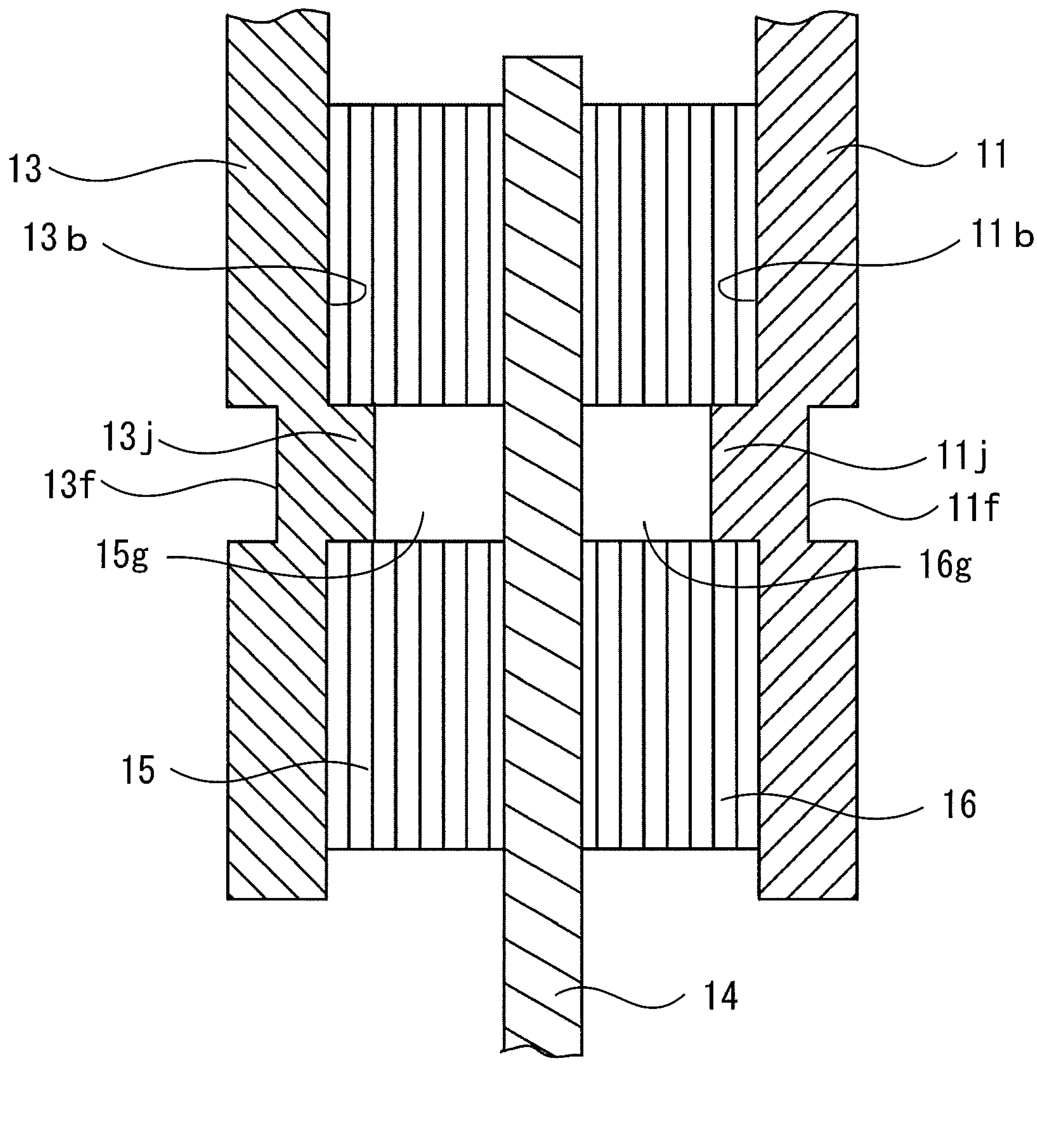


FIG. 9A

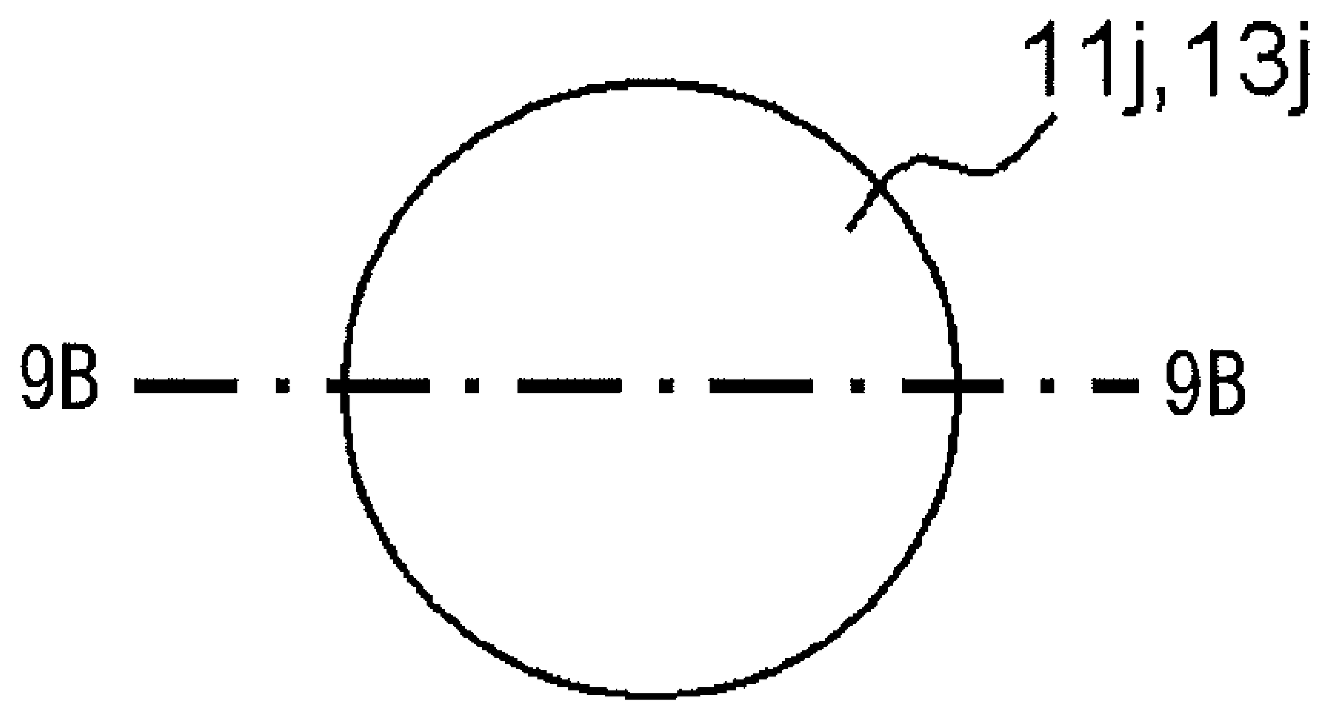


FIG. 9B

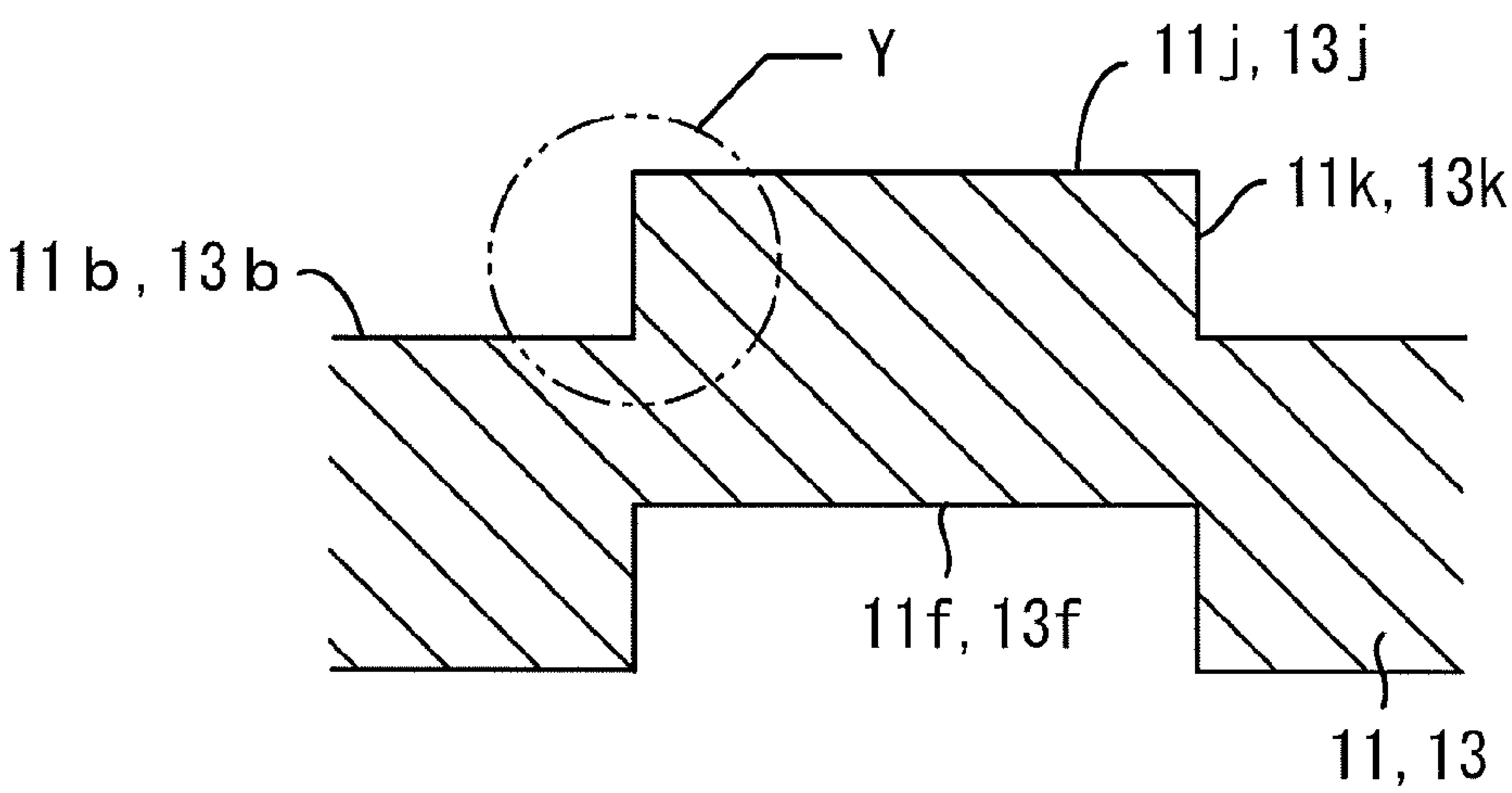
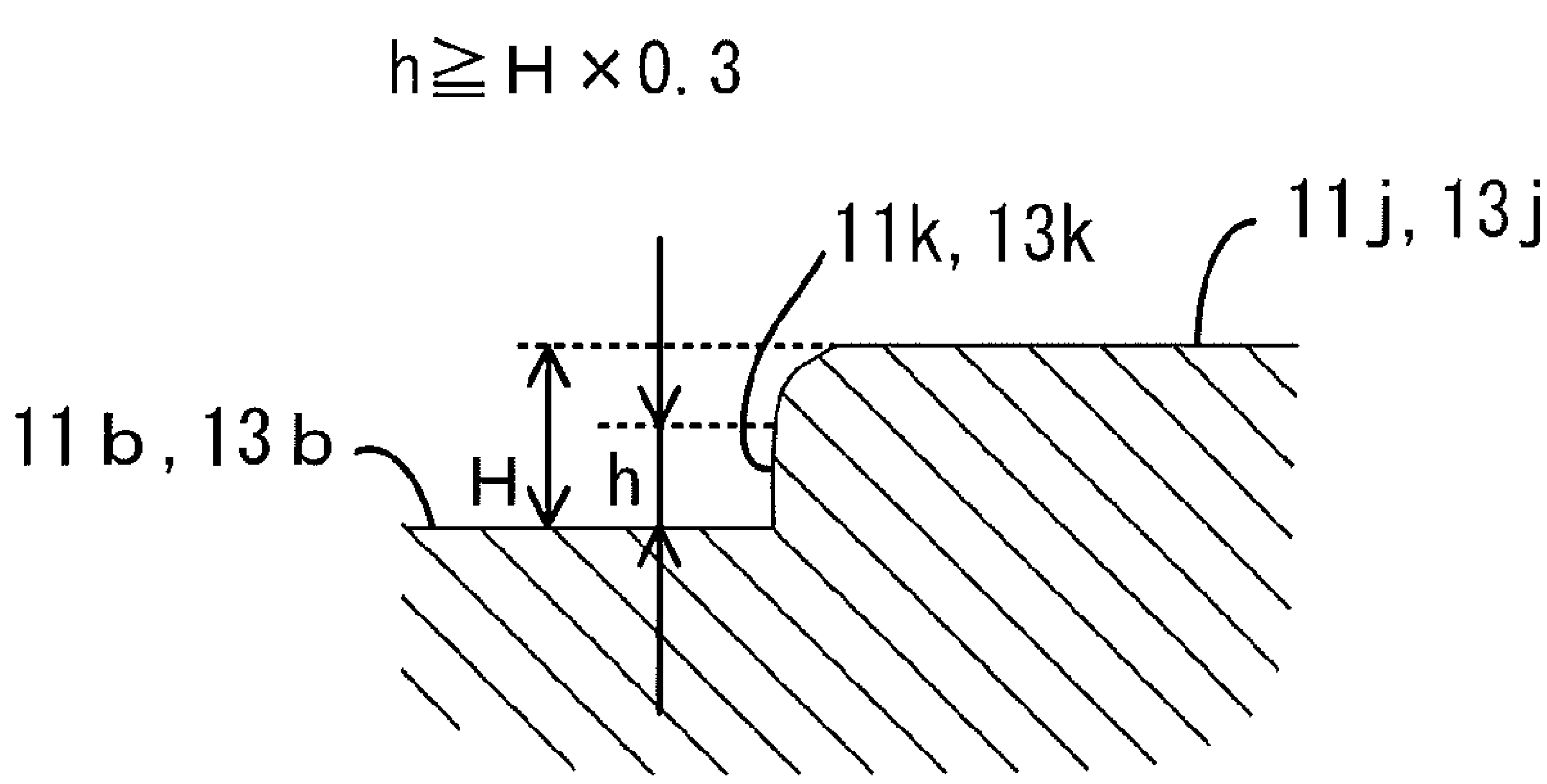


FIG. 9C



F I G. 10

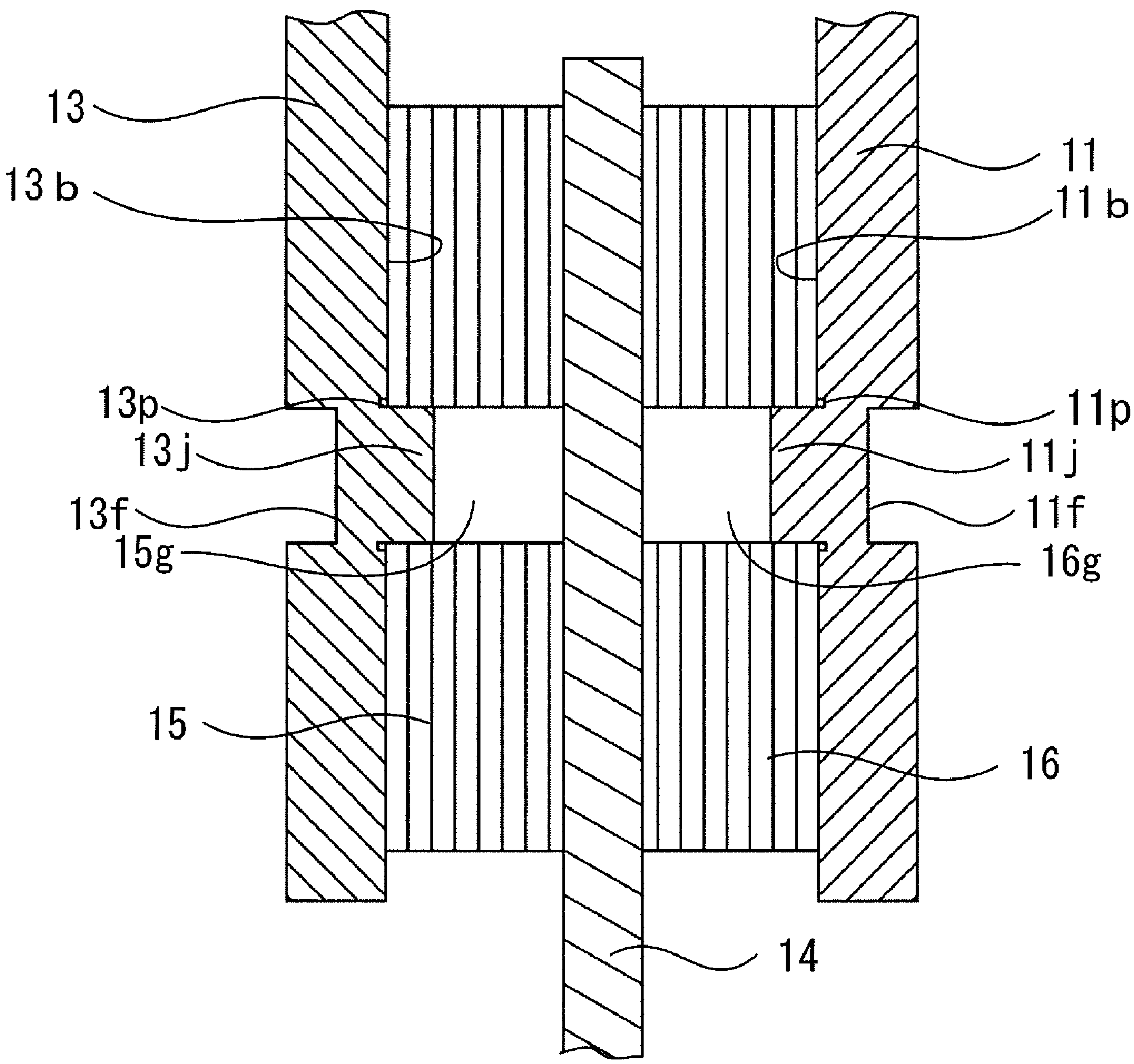


FIG. 11A

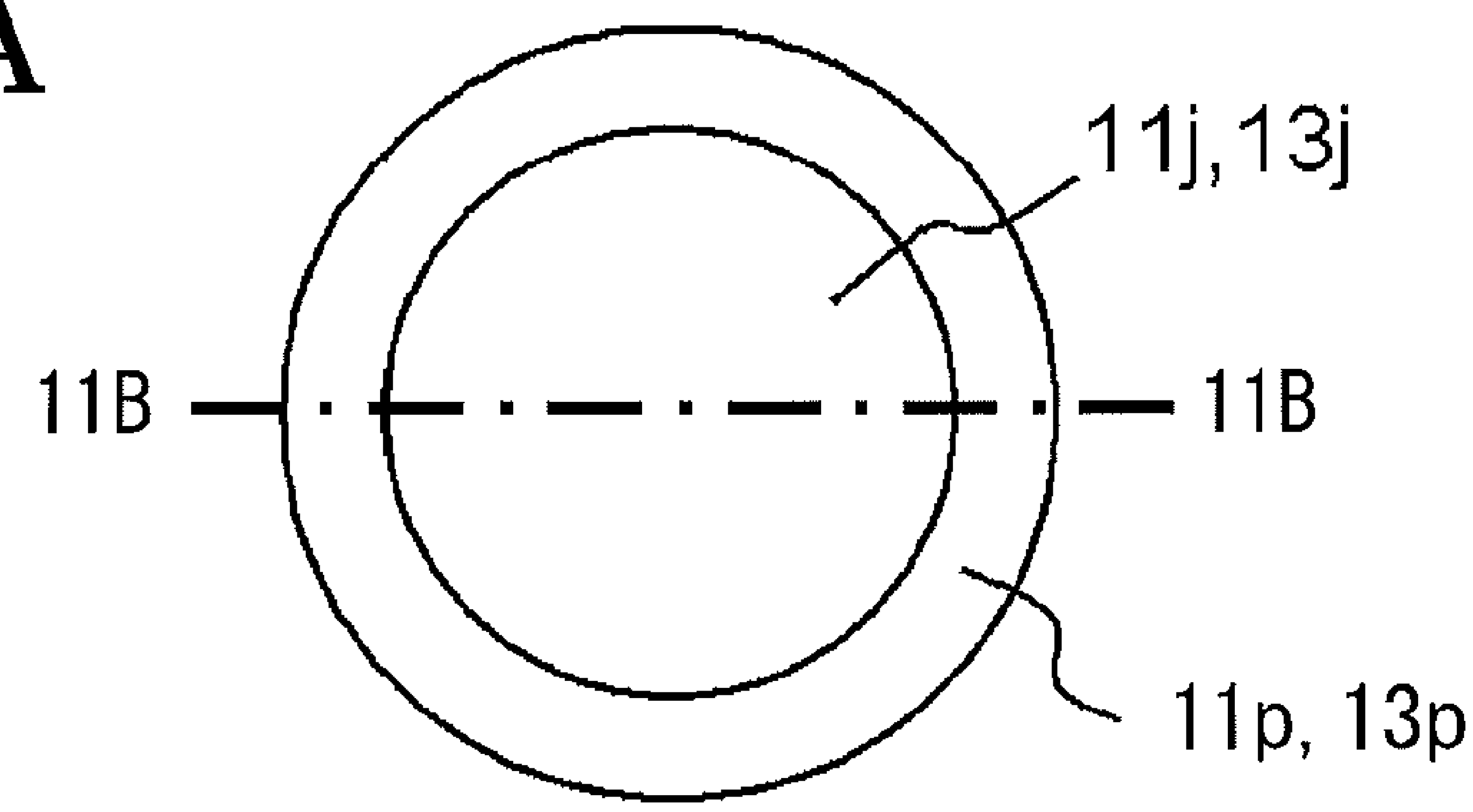


FIG. 11B

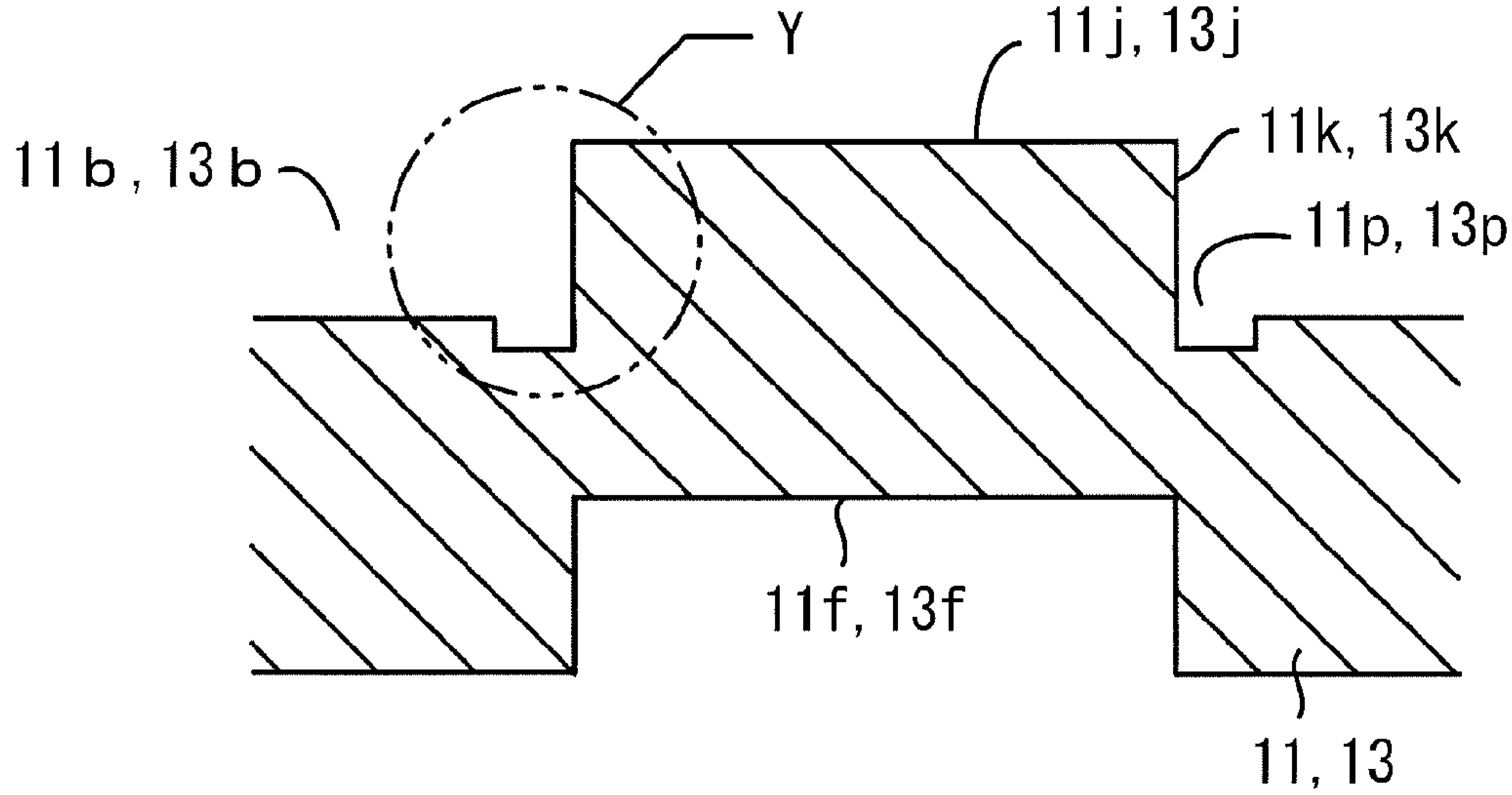
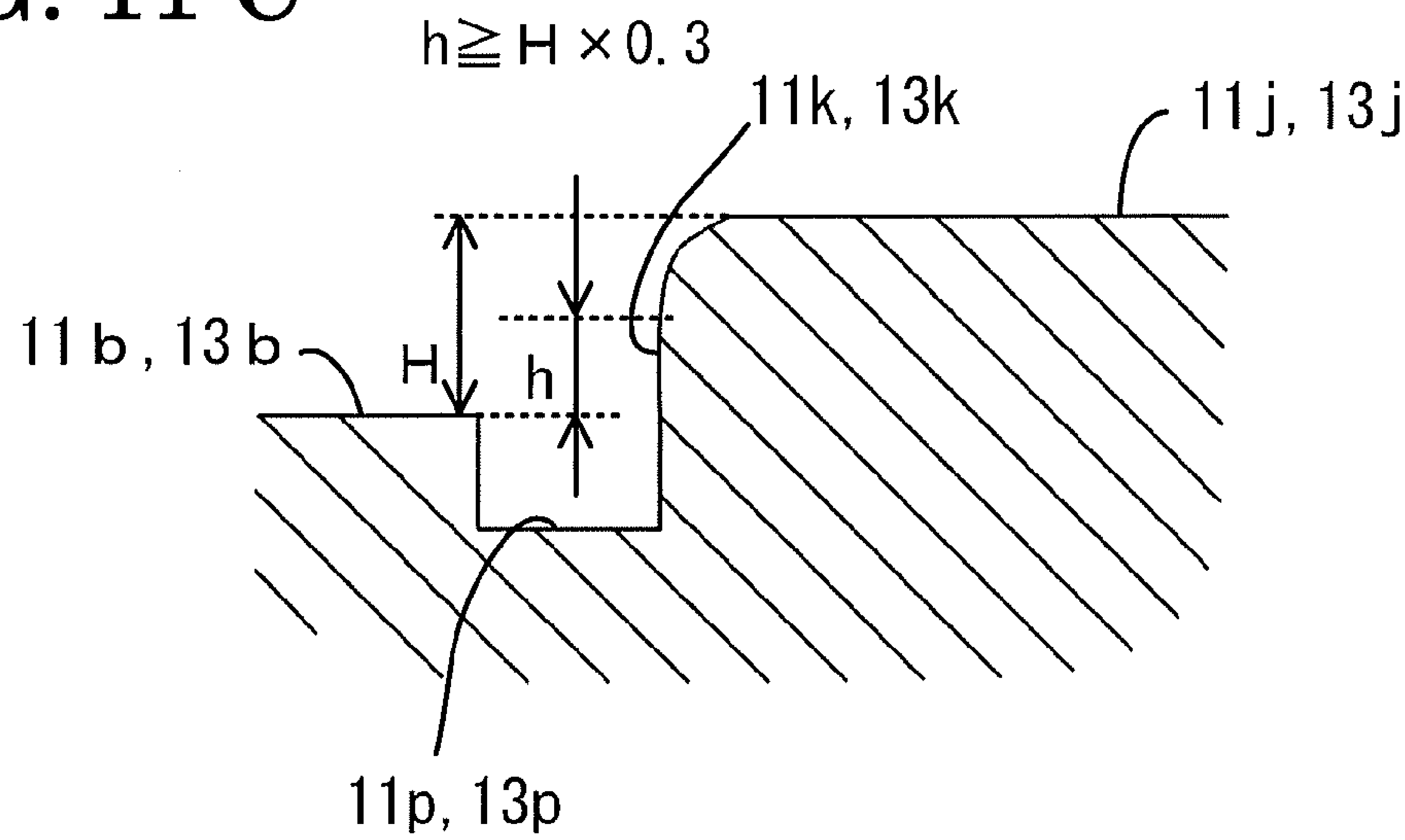
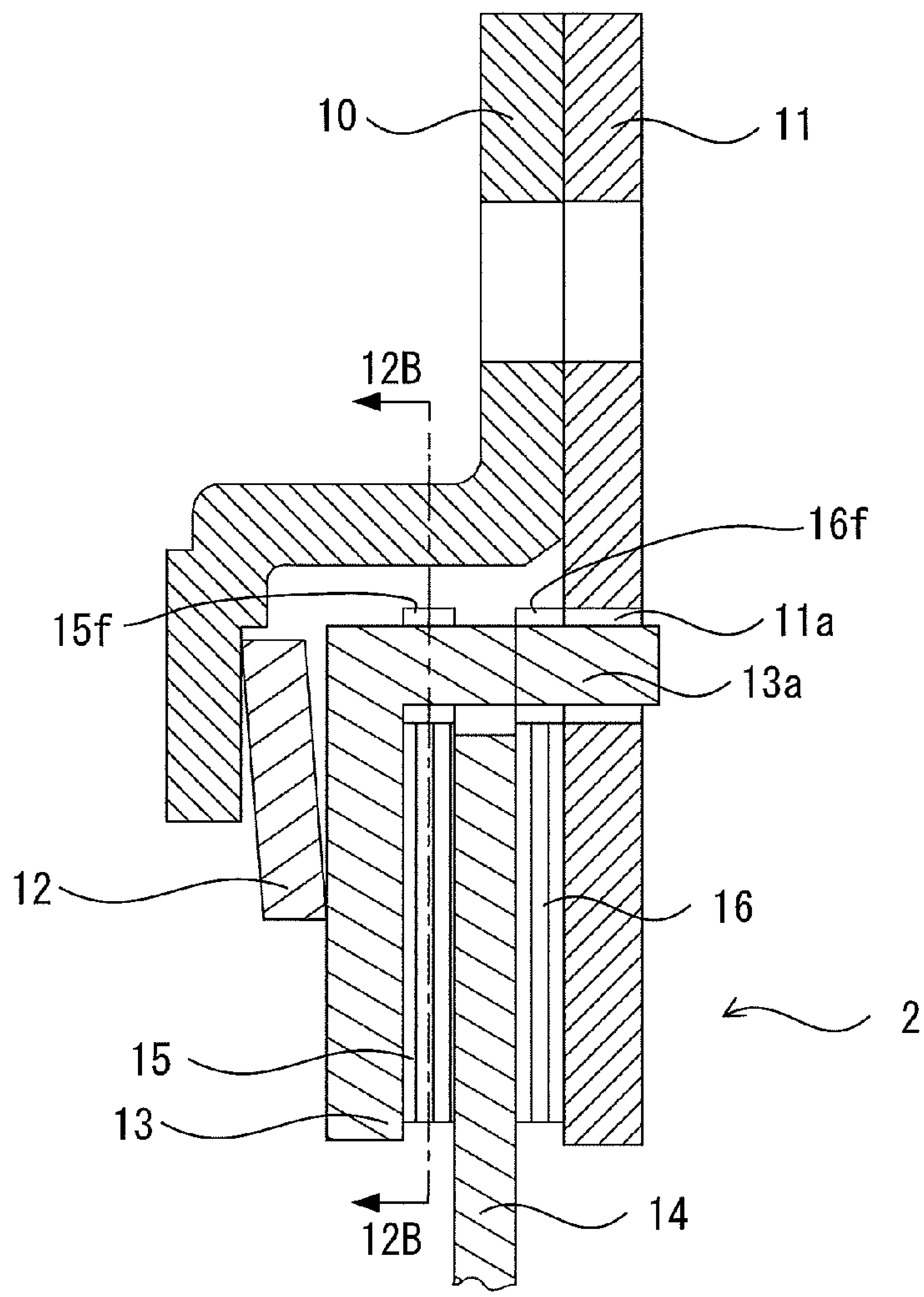


FIG. 11C



F I G. 12 A



F I G. 12 B

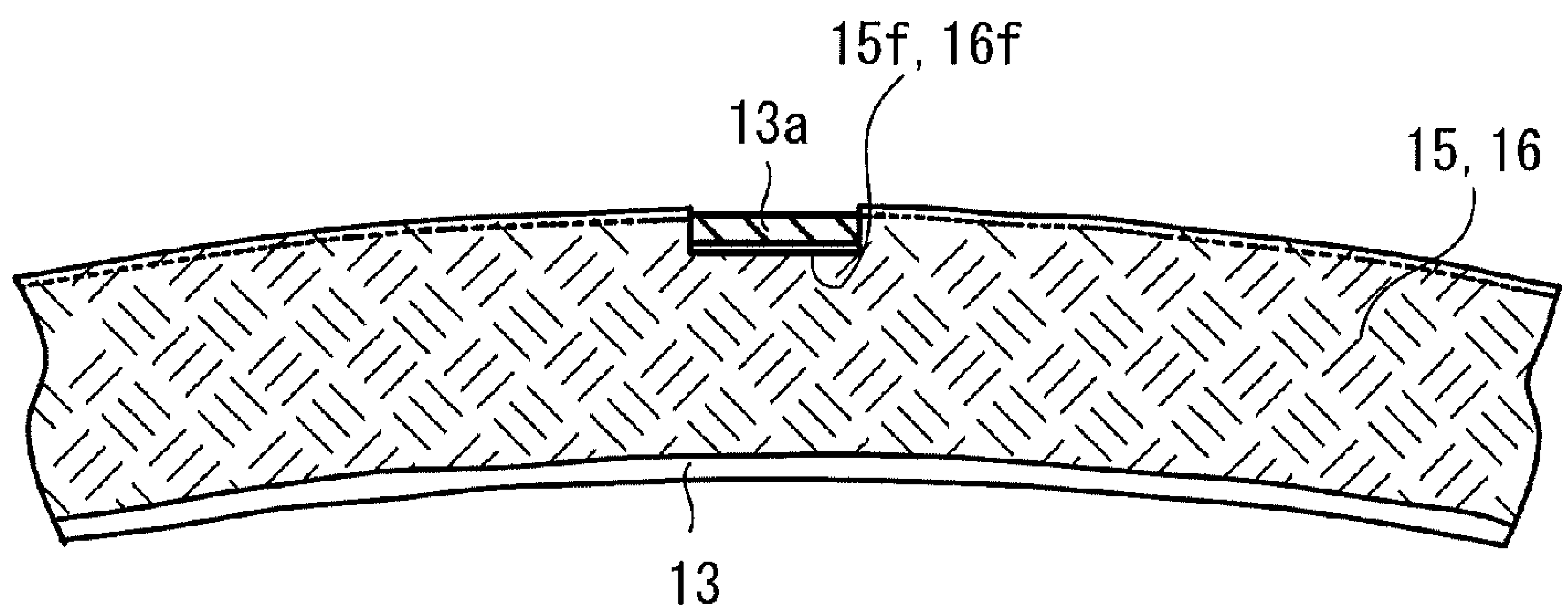


FIG. 13A

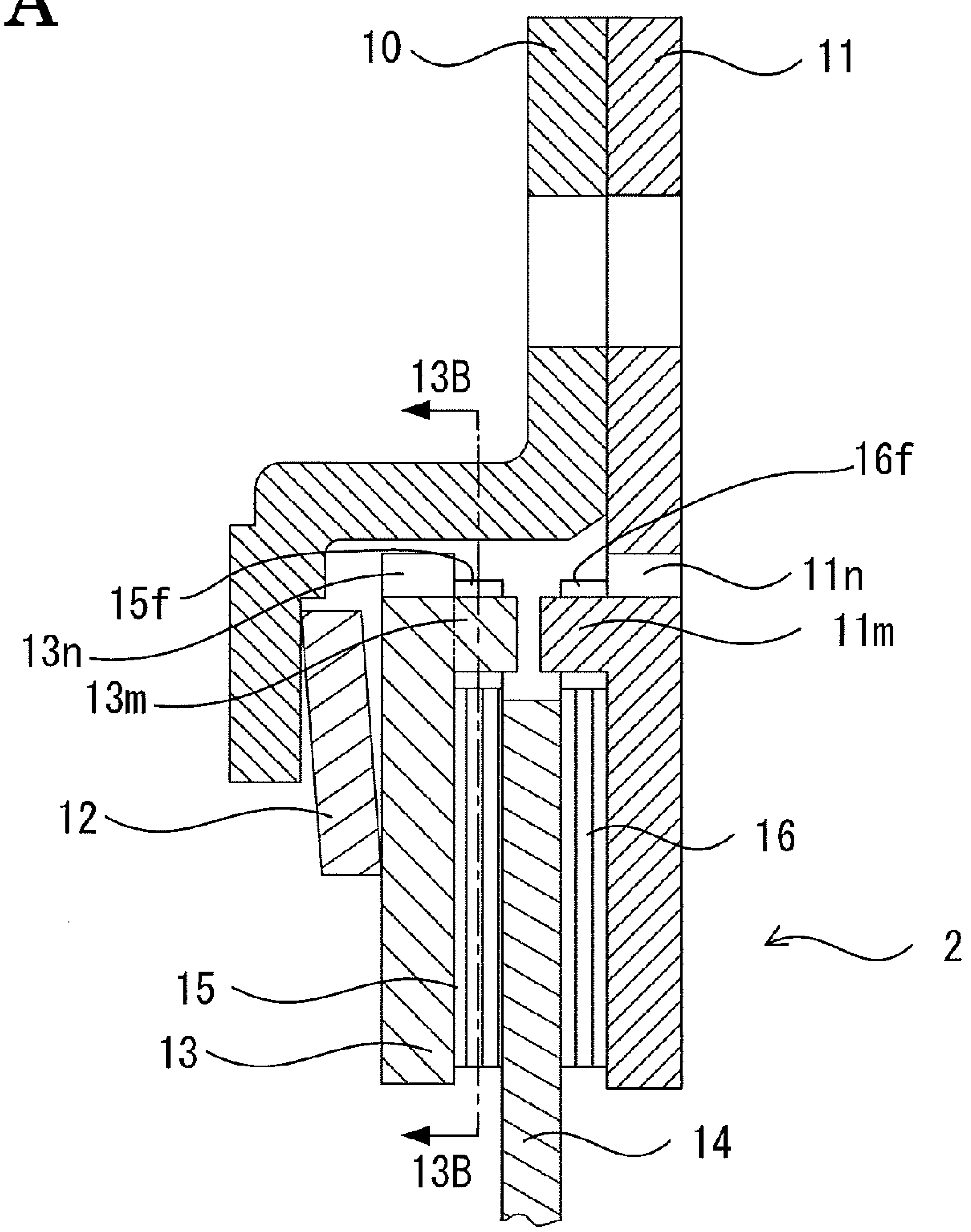
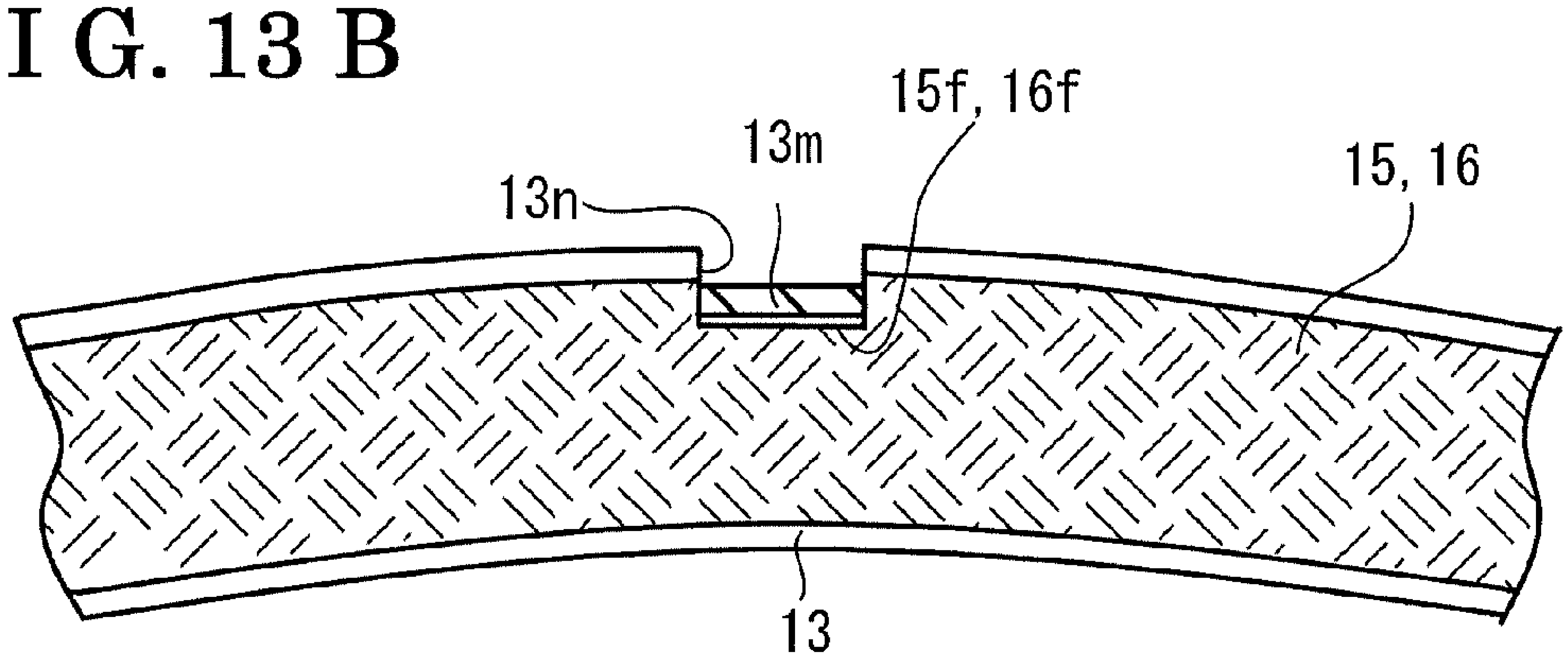


FIG. 13B



TORQUE FLUCTUATION ABSORBING APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 U.S.C. §119 to Japanese Patent Applications 2009-246636, filed on Oct. 27, 2009, and 2010-228722 filed on Oct. 8, 2010 the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

This disclosure relates to a torque fluctuation absorbing apparatus, which absorbs a fluctuating torque between rotating shafts, and includes a limiter portion that generates slippage when the fluctuating torque reaches a predetermined value.

BACKGROUND DISCUSSION

A known torque fluctuation absorbing apparatus is provided, for example, on a drivetrain between an engine and a clutch, and absorbs (restrains) a fluctuating torque generated by an engine and a transmission. The known torque fluctuation absorbing apparatus includes, for example, a damper portion that absorbs the fluctuating torque by means of a spring force, a hysteresis portion that absorbs the fluctuating torque by means of a hysteresis torque generated by friction or the like, and a limiter portion that generates slippage when a torsion of respective rotating shafts of the engine and the transmission is beyond absorption capabilities of the damper portion and the hysteresis portion. The limiter portion includes a lining plate that is provided between a pressure plate and a cover plate. Friction members are fixedly attached to respective side surfaces (i.e., both axial sides) of the lining plate. The limiter portion also includes a disc spring that is provided between a support plate and the pressure plate. The disc spring biases the pressure plate towards the lining plate to thereby push the lining plate towards the cover plate. Accordingly, the friction members fixedly attached to the lining plate are pressed against the pressure plate and the cover plate respectively.

The friction members fixedly attached to the respective side surfaces of the lining plate are generally riveted to the lining plate. JP2005-127507A discloses a torque fluctuation absorbing apparatus in which friction members are adhered to a lining plate or are integrated with the lining plate by means of a through hole formed on the lining plate.

In case the friction members are adhered to the lining plate such as in the limiter portion of the torque fluctuation absorbing apparatus disclosed in JP2005-127507A, the adhesion process may take more time to conduct, thereby increasing a cost. In addition, the adhesive may be insufficiently spread to surfaces via which the friction members and the lining plate are adhered, which may lead to an issue related to the strength of the friction members. Further, in a structure where the friction members are integrated with the lining plate by means of the through hole formed on the lining plate, the friction members may be insufficiently received by the through hole and there may be an issue related to the strength of the friction members.

A need thus exists for a torque fluctuation absorbing apparatus which is not susceptible to the drawback mentioned above.

SUMMARY

According to an aspect of this disclosure, a torque fluctuation absorbing apparatus includes a first plate member, a second plate member rotatable relative to the first plate member, and a first friction member disposed between the first plate member and the second plate member and pressed against the first plate member in a slidable manner. The second plate member includes a first retaining surface that makes contact with the first friction member. The first friction member includes a plurality of grooves at a surface facing the first retaining surface of the second plate member, the grooves extending in a radial direction of the first friction member.

According to another aspect of this disclosure, a torque fluctuation absorbing apparatus includes a first plate member, a second plate member rotatable relative to the first plate member, and a first friction member disposed between the first plate member and the second plate member and pressed against the first plate member in a slidable manner. The second plate member includes a first engagement projection at the first retaining surface. The first friction member includes a first engagement portion formed into either a hole shape, a recess shape, or a cut shape at a surface facing the second plate member, the first engagement portion engaging with the first engagement projection of the second plate member.

According to a further aspect of this disclosure, a torque fluctuation absorbing apparatus includes a first plate member, a second plate member rotatable relative to the first plate member, a first friction member disposed between the first plate member and the second plate member and pressed against the first plate member in a slidable manner, a third plate member arranged at an opposite side of the second plate member relative to the first plate member and being rotatable relative to the first plate member, and a second friction member disposed between the first plate member and the third plate member and pressed against the first plate member in a slidable manner. The third plate member includes a hole and the second plate member includes a detent inserted into the hole of the third plate member in a relatively unrotatable manner and an axially movable manner. The first and second friction members include respective engagement cut portions engaging with the detent of the second plate member.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and additional features and characteristics of this disclosure will become more apparent from the following detailed description considered with the reference to the accompanying drawings, wherein:

FIG. **1** is a partial radial section view schematically illustrating a structure of a torque fluctuation absorbing apparatus according to a first embodiment disclosed here;

FIG. **2**A is a partial plane view schematically illustrating a structure of a retaining surface of a cover plate and a retaining surface of a pressure plate according to the first embodiment;

FIG. **2**B is a partial section view taken on line **2**B-**2**B illustrated in FIG. **2**A;

FIG. **2**C is a partial section view of an area Y illustrated in FIG. **2**B;

FIG. **3**A is a partial plane view schematically illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to a second embodiment disclosed here;

FIG. **3**B is a partial section view taken on line **3**B-**3**B illustrated in FIG. **3**A;

FIG. **4**A is a partial plane view schematically illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to a third embodiment disclosed here;

FIG. **4**B is a partial section view taken on line **4**B-**4**B illustrated in FIG. **4**A;

FIG. **5**A is a first partial plane view schematically illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to a fourth embodiment disclosed here;

FIG. **5**B is a second partial plane view schematically illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to the fourth embodiment;

FIG. **5**C is a partial section view illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to the fourth embodiment;

FIG. **6**A is a partial plane view schematically illustrating a structure of the friction members according to a fifth embodiment disclosed here;

FIG. **6**B is a partial section view taken on line **6**B-**6**B illustrated in FIG. **6**A;

FIG. **7** is a partial radial section view schematically illustrating the structure of the limiter portion according to a sixth embodiment disclosed here;

FIG. **8** is a partial radial section view schematically illustrating the structure of the limiter portion according to a seventh embodiment disclosed here;

FIG. **9**A is a partial plane view schematically illustrating projections formed at the cover plate and the pressure plate according to the seventh embodiment;

FIG. **9**B is a partial section view taken on line **9**B-**9**B illustrated in FIG. **9**A;

FIG. **9**C is an enlarged section view of an area Y illustrated in FIG. **9**B;

FIG. **10** is a partial radial section view schematically illustrating the structure of the limiter portion according to an eighth embodiment disclosed here;

FIG. **11**A is a partial plane view schematically illustrating the structure of the retaining surface of the cover plate and the retaining surface of the pressure plate according to the eighth embodiment;

FIG. **11**B is a partial section view taken on line **11**B-**11**B illustrated in FIG. **11**A;

FIG. **11**C is an enlarged section view of an area Y illustrated in FIG. **11**B;

FIG. **12**A is a partial radial section view schematically illustrating the structure of the limiter portion according to a ninth embodiment disclosed here;

FIG. **12**B is a partial section view taken on line **12**B-**12**B illustrated in FIG. **12**A;

FIG. **13**A is a partial radial section view schematically illustrating the structure of the limiter portion according to a tenth embodiment disclosed here; and

FIG. **13**B is a partial section view taken on line **13**B-**13**B illustrated in FIG. **13**A.

DETAILED DESCRIPTION

A first embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **1** is a partial radial section view schematically illustrating a torque fluctuation absorbing apparatus **1** according to a first embodiment. FIG. **2**A is a partial plane view schematically illustrating a structure of a retaining surface **11***b* of a cover plate **11** and a retaining surface **13***b* of a pressure plate **13** according to the first embodiment. FIG. **2**B is a partial section view taken on line **2**B-**2**B illustrated in FIG. **2**A. FIG. **2**C is a partial section view of an area Y illustrated in FIG. **2**B.

As shown in FIG. **1**, the torque fluctuation absorbing apparatus **1** is provided, for example, on a drivetrain between a rotating shaft **6** that is coupled to an engine and a rotating shaft **7** that is coupled to a transmission so as to absorb (restrain) a fluctuating torque generated by a torsion of the rotating shaft **6** and the rotating shaft **7**, that is, a torque fluctuation between the rotating shaft **6** and the rotating shaft **7**. The torque fluctuation absorbing apparatus **1** includes a damper portion **3**, a hysteresis portion **4** and a limiter portion **2**. The damper portion **3** has a torsion-absorbing function and absorbs the fluctuating torque by means of a spring force. The hysteresis portion **4** absorbs (restrains) the fluctuating torque by means of a hysteresis torque generated by friction or the like. The limiter portion **2** generates slippage when the torsion of the rotating shaft **6** and the rotating shaft **7** is beyond absorption capabilities of the damper portion **3** and the hysteresis portion **4**. The limiter portion **2** is placed parallelly with the damper portion **3** and with the hysteresis portion **4** in the drivetrain. The damper portion **3** is placed serially with the hysteresis portion **4** in the drivetrain. The torque fluctuation absorbing apparatus **1** is applicable to a hybrid vehicle that has no limiter portion. The torque fluctuation absorbing apparatus **1** is also applicable to a vehicle having the limiter portion and is effective in downsizing of a drivetrain system.

The torque fluctuation absorbing apparatus **1** includes a support plate **10**, the cover plate **11** serving as a third plate member, a disc spring **12**, the pressure plate **13** serving as a second plate member, a lining plate **14** serving as a first plate member, friction members **15**, **16** serving as first and second friction members, a first side plate **17**, a second side plate **18**, a rivet **19**, a coil spring **20**, a seat member **21**, a first thrust member **22**, a second thrust member **23**, a disc spring **24** and a hub member **25**.

In the embodiments of this disclosure, the terms "axial", "radial", "circumferential", "peripheral" and derivatives thereof are used based on the lining plate **14**, unless otherwise specified. The support plate **10**, which constitutes the limiter portion **2**, is formed into a ring shape and placed axially between a flywheel **5** and the cover plate **11**. A radially outward portion of the support plate **10** is in contact with the cover plate **11** in an axial direction and is securely fastened, together with the cover plate **11**, to the flywheel **5** by means of a bolt **9**. A radially inward portion of the support plate **10** is axially apart from the cover plate **11**. The support plate **10** and the disc spring **12** are pressed against each other. The flywheel **5** is mounted on the rotating shaft **6** that is coupled to the engine by means of a bolt **8**.

The cover plate **11**, which constitutes the limiter portion **2**, is formed into a ring shape and is placed on the opposite side to the flywheel **5** relative to the support plate **10** (on the right side relative to the support plate **10** in FIG. **1**). That is, the flywheel **5**, the support plate **10**, the cover plate **11** and the transmission are axially arranged in this order, the flywheel **5** being closest to the engine. A radially outward portion of the cover plate **11** is in contact with the support plate **10** in the axial direction, and is securely fastened, together with the support plate **10**, to the flywheel **5** by means of the bolt **9**. A radially inward portion of the cover plate **11** is axially apart from the support plate **10**. The cover plate **11** includes a hole **11***a* which supports the pressure plate **13** in a manner that the pressure plate **13** moves in the axial direction but the pressure plate **13** does not rotate relative to the cover plate **11**. A detent **13***a* of the pressure plate **13** is inserted into the hole **11***a* so as to move in the axial direction but so as not to rotate relative to the cover plate **11**. The cover plate **11** includes the retaining surface **11***b*, serving as a second retaining surface, that retains the friction member **16** at the radially inward portion of the cover plate **11**. A treatment for increasing a friction coefficient is conducted on the retaining surface **11***b*, which makes it difficult to move the friction member **16** relative to the cover plate **11**. Accordingly, a position where the friction member **16** is retained relative to the cover plate **11** is determined. The friction coefficient between the retaining surface **11***b* and the friction member **16** is set to be greater than a friction coefficient between the lining plate **14** and the friction member **16**.

As shown in FIGS. **2**A, **2**B and **2**C, the retaining surface **11***b* includes a recess **11***c* and a projection **11***d*. The recess **11***c* is formed on a flat surface (i.e., a flat portion) of the retaining surface **11***b* and is recessed, that is, dented, relative to the flat portion. The projection **11***d* is formed around a peripheral edge of the recess **11***c* so as to project, that is, to be raised, from the flat portion. The recess **11***c* and the projection **11***d* are formed by die punching performed on the retaining surface **11***b*. An area that is processed in a single punching action, i.e., by the die punching one time (the area indicated by the dashed line in FIG. **2**A) includes a predetermined pattern formed by the recess **11***c* (including the projection **11***d*). The area (i.e. a punched area) includes four or more of the recesses **11***c*, desirably, for example, ten to thirty recesses **11***c*. A diameter of the punched area is 20 millimeters or less, and the retaining surface **11***b* includes multiple punched areas, desirably, for example, six or more punched areas. A height of the projection **11***d* from the flat portion is, desirably, for example, 0.01 millimeters or more. The recess **11***c* is shaped so that the center of the bottom of the recess **11***c* is the deepest and that the center of the bottom makes an angle of, desirably, for example, 120 degrees or less when viewed in the cross section (refer to FIG. **2**C). The retaining surface **11***b* may be entirely or partially formed by one of or both of the projections **11***d* and the recesses **11***c* for generating a slip resistance relative to the friction member **16**.

The disc spring **12**, which constitutes the limiter portion **2**, is placed axially between the support plate **10** and the pressure plate **13** as shown in FIG. **1**. The disc spring **12** biases the pressure plate **13** toward the friction member **15**.

The pressure plate **13**, which constitutes the limiter portion **2**, is formed into a ring shape and is placed axially between the disc spring **12** and the friction member **15**. The pressure plate **13** includes the detent **13***a* by which the pressure plate **13** is supported relative to the cover plate **11** in the manner to move in the axial direction but not to rotate relative to the cover plate **11**. The detent **13***a* is inserted into the hole **11***a* of the cover plate **11** so as to move in the axial direction but so as not to move in the circumferential direction of the cover plate **11** relative to the cover plate **11**. The pressure plate **13** is biased toward the friction member **15** by the disc spring **12**. The pressure plate **13** includes the retaining surface **13***b*, serving as a first retaining surface, that retains the friction member **15**. A treatment for increasing a friction coefficient is conducted on the retaining surface **13***b*, which makes it difficult to move the friction member **15** relative to the pressure plate **13**. Accordingly, a position where the friction member **15** is retained relative to the pressure plate **13** is determined. The friction coefficient between the retaining surface **13***b* and the friction member **15** is set to be greater than a coefficient friction between the lining plate **14** and the friction member **15**.

As shown in FIGS. **2**A, **2**B and **2**C, the retaining surface **13***b* includes a recess **13***c* and a projection **13***d*. The recess **13***c* is formed on a flat surface (i.e., a flat portion) of the retaining surface **13***b* and is recessed, that is, dented, relative to the flat portion. The projection **13***d* is formed around a peripheral edge of the recess **13***c* so as to project, that is, to be raised, from the flat portion. The recess **13***c* and the projection **13***d* are formed by die punching performed on the retaining surface **13***b*. The area that is processed in the single punching action (the area indicated by the dashed line in FIG. **2**A) includes the predetermined pattern formed by the recess **13***c* (including the projection **13***d*). The area (i.e. the punched area) includes four or more of the recesses **13***c*, desirably, for example, ten to thirty recesses **13***c*. A diameter of the punched area is 20 millimeters or less, and the retaining surface **13***b* includes multiple punched areas, desirably, for example, six or more punched areas, on the retaining surface **13***b*. A height of the projection **13***d* from the flat portion is, desirably, for example, 0.01 millimeters or more. The recess **13***c* is shaped so that the center of the bottom of the recess **13***c* is the deepest and that the center of the bottom makes an angle of, for example, 120 degrees or less when viewed in the cross section (refer to FIG. **2**C). The retaining surface **13***b* may be entirely or partially formed by one of or both of the projections **13***d* and the recesses **13***c* for generating a slip resistance relative to the friction member **15**.

The lining plate **14**, which constitutes the limiter portion **2**, is formed into a ring shape and is placed axially between the friction members **15** and **16** both of which are placed axially between the pressure plate **13** and the cover plate **11** as shown in FIG. **1**. A radially inward portion of the lining plate **14** is sandwiched between the first side plate **17** and the second side plate **18**. The lining plate **14**, the first side plate **17** and the second side plate **18** are securely fastened to one another by means of the rivet **19**. A radially outward portion of the lining plate **14** extends to be positioned axially between the friction members **15** and **16**, and is pressed against the friction members **15**, **16** in a manner that the lining plate **14** circumferentially slides relative to the friction members **15**, **16**. The lining plate **14** may be made of a material that is less likely to rust (desirably, for example, a stainless material) in order to prevent the lining plate **14** from sticking to the friction members **15**, **16** due to the rust. In order to ensure a friction coefficient μ, a surface treatment (for example, plating), a heat treatment or a surface roughing treatment may be desirably performed on the lining plate **14**. To perform the surface roughing treatment, a projection-and-recess pattern may be transferred on the surface of the lining plate **14** by means of a roller. Alternatively, an abrasive paper or an abrasive brush may be used to polish the surface of the lining plate **14**. The friction coefficient between the lining plate **14** and the friction member **16** is set to be smaller than the friction coefficient between the retaining surface **11***b* of the cover plate **11** and the friction member **16**. The friction coefficient between the lining plate **14** and the friction member **15** is set to be smaller than the friction coefficient between the retaining surface **13***b* of the pressure plate **13** and the friction member **15**.

The friction member **15**, which constitutes the limiter portion **2**, is placed axially between the lining plate **14** and the pressure plate **13** as shown in FIG. **1**. The friction member **15** is formed into a ring shape and, a surface of the friction member **15** is formed to be flat. The friction member **15** is retained by the retaining surface **13***b* of the pressure plate **13**. The friction member **15** is pressed against the lining plate **14** in a manner that the friction member **15** circumferentially slides relative to the lining plate **14**. The friction member **15** may be made of a material that includes rubber, resin, fiber (short fiber or long fiber), particles for adjusting the friction coefficient μ, or the like.

The friction member **16**, which constitutes the limiter portion **2**, is placed axially between the lining plate **14** and the cover plate **11** as shown in FIG. **1**. The friction member **16** is formed into a ring shape and, a surface of the friction member **16** is formed to be flat. The friction member **16** is retained by the retaining surface **11***b* of the cover plate **11**. The friction member **16** is pressed against the lining plate **14** in a manner that the friction member **16** circumferentially slides relative to the lining plate **14**.

The first side plate **17**, which constitutes the damper portion **3** and the hysteresis portion **4**, is formed into a ring shape and is placed axially between a flange **25***b* of the hub member **25** and the engine (on the left side of the flange **25***b* in FIG. **1**). A portion that is approximate to a radially outward end of the second side plate **17**, the lining plate **14** and the second side plate **18** are fastened integrally with one another by means of the rivet **19**. The first side plate **17** includes, in the damper portion **3** that is positioned in a radially intermediate portion of the side plate **17**, a window portion **17***a* for accommodating the coil spring **20** and the seat member **21**. Each of the circumferential end faces of the window portion **17***a* is in contact with the seat member **21** so as to be in and out of contact with the seat member **21**. The first side plate **17** is in contact with the first thrust member **22** in a manner that the side plate **17** circumferentially slides relative to the thrust member **22** at a radially more inward portion than the damper portion **3**, i.e., the hysteresis portion **4**. A radially inward end of the first side plate **17** is supported by the hub member **25** (a hub portion **25***a*) via the first thrust member **22** so as to be rotatable relative to the hub member **25**.

The second side plate **18**, which constitutes the damper portion **3** and the hysteresis portion **4**, is formed into a ring shape and is placed between the flange **25***b* of the hub member **25** and the transmission (on the right side of the flange **25***b* in FIG. **1**). A portion that is approximate to a radially outward end of the second side plate **18**, the lining plate **14** and the first side plate **17** are fastened integrally with one another by means of the rivet **19**. The second side plate **18** includes, in the damper portion **3** that is positioned in a radially intermediate portion of the side plate **18**, a window portion **18***a* for accommodating the coil spring **20** and the seat member **21**. Each of the circumferential end faces of the window portion **18***a* is in contact with the seat member **21** so as to be in and out of contact with the seat member **21**. The second side plate **18** supports the disc spring **24** at a radially more inward portion than the damper portion **3**, i.e., the hysteresis portion **4**. A radially inward end of the second side plate **18** is supported by the hub member **25** (the hub portion **25***a*) via the second thrust member **23** so as to be rotatable relative to the hub member **25**.

The rivet **19** fastens the lining plate **14**, the first side plate **17** and the second side plate **18** integrally with one another.

The coil spring **20**, which constitutes the damper portion **3**, is accommodated in the window portion **17***a*, the window portion **18***a* and a window portion **25***c* that are formed at the first side plate **17**, the second side plate **18** and the hub member **25** (the flange **25***b*) respectively. The circumferential ends of the coil spring **20** are in contact with the seat members **21**, **21** that are provided on the circumferential ends of the coil spring **20**. The coil spring **20** is compressed when the side plates **17**, **18** rotate relative to the hub member **25**, and absorbs a shock generated by a rotational difference between the side plates **17**, **18** and the hub member **25**. The coil spring **20** may be formed to have a straight shape in the circumferential direction of the first and second side plates **17**, **18**. Alternatively, the coil spring **20** may be formed into the straight shape, and then may be bent to form an arc in the circumferential direction of the first and second side plates **17**, **18** while being assembled. Alternatively, an arc spring having the arc shape in the circumferential direction of the side plates **17**, **18** may be used so as to respond to a large torsion.

The seat members **21**, which constitute the damper portion **3**, are accommodated in the window portion **17***a*, the window portion **18***a* and the window portion **25***c* that are formed at the side plate **17**, the side plate **18** and the hub member **25** (the flange **25***b*) respectively. The seat members **21** are provided between the circumferential end faces of the window portions **17***a*, **18***a*, **25***c*, and the circumferential ends of the coil spring **20**. The seat member **21** may be made of resin so as to decrease abrasion of the coil spring **20**.

The first thrust member **22**, which constitutes the hysteresis portion **4**, is formed into a ring shape and is placed between the first side plate **17** and the hub member **25**. The first thrust member **22** is positioned between the first side plate **17** and the flange **25***b* in the axial direction, and is pressed against the first side plate **17** and against the flange **25***b* in a manner that the first thrust member **22** circumferentially slides relative to the first side plate **17** and the flange **25***b*. Also, the first thrust member **22** is positioned between the first side plate **17** and the hub portion **25***a* in the radial direction, and serves as a sliding bearing (a bush) supporting the first side plate **17** so that the first side plate **17** rotates relative to the hub portion **25***a*.

The second thrust member **23**, which constitutes the hysteresis portion **4**, is formed into a ring shape and is placed between the second side plate **18** and the hub member **25**. The second thrust member **23** is positioned between the disc spring **24** and the flange **25***b* in the axial direction, and is biased toward the flange **25***b* by the disc spring **24** so that the second thrust member **23** is pushed against the flange **25***b* in a circumferentially slidable manner relative to the flange **25***b*. Also, the second thrust member **23** is positioned between the second side plate **18** and the hub portion **25***a* in the radial direction, and serves as a sliding bearing (a bush) supporting the second side plate **18** so that the second side plate **18** rotates relative to the hub portion **25***a*.

The disc spring **24** is a disc-shaped spring constituting the hysteresis portion **4**. The disc spring **24** is provided axially between the second thrust member **23** and the second side plate **18** so as to bias the second thrust member **23** toward the flange **25***b*.

The hub member **25** constitutes the damper portion **3** and the hysteresis portion **4**, and outputs a rotative power which is transmitted from the damper portion **3** and the hysteresis portion **4** to the transmission. The hub member **25** includes the flange **25***b* radially outwardly protruding from an outer periphery of the hub portion **25***a*. An inner periphery of the hub portion **25***a* is spline-engaged with the rotating shaft **7** that is coupled to the transmission. The outer periphery of the hub portion **25***a* supports the first side plate **17** via the first thrust member **22**, and supports the second side plate **18** via the second thrust member **23** in a manner that the first side plate **17** and the second side plate **18** rotate relative to the hub portion **25***a*. The flange **25***b* includes, in the damper portion **3** positioned in a radially outward portion of the flange **25***b*, the window portion **25***c* for accommodating the coil spring **20** and the seat members **21**. Each of the circumferential end faces of the window portion **25***c* is in contact with the seat member **21** so as to be in and out of contact with the seat member **21**. The flange **25***b* is supported by the first thrust member **22** and the second thrust member **23** at the radially more inward portion than the damper portion **3**, i.e., at the hysteresis portion **4**. More particularly, the flange **25***b* is axially sandwiched, in the hysteresis portion **4**, between the first thrust member **22** and the second thrust member **23** in a manner that the flange **25**b circumferentially slides relative to the first thrust member **22** and the second thrust member **23**.

In the first embodiment, axial surfaces of the lining plate **14**, which oppose the friction members **15**, **16** respectively, refer to sliding surfaces. An axial surface of the cover plate **11**, which opposes the friction member **16**, and an axial surface of the pressure plate **13**, which opposes the friction member **15**, refer to the retaining surfaces. Alternatively, the recesses **11**c, **13**c and the projections **11**d, **13**d shown in FIGS. **2**A, **2**B and **2**C may be formed on the lining plate **14** instead of on the cover plate **11** and on the pressure plate **13**. In this case, the axial surfaces of the lining plate **14**, which oppose the friction members **15**, **16** respectively, refer to the retaining surfaces. The axial surface of the cover plate **11**, which opposes the friction member **16**, and the axial surface of the pressure plate **13**, which opposes the friction member **15**, refer to the sliding surface.

According to the first embodiment, the recesses **11**c, **13**c and the projections **11**d, **13**d are formed on the cover plate **11** and on the pressure plate **13**. Accordingly, the axial surfaces of the lining plate **14**, which oppose the friction members **15**, **16** respectively, refer to the sliding surfaces, the axial surface of the cover plate **11**, which opposes the friction member **16**, and the axial surface of the pressure plate **13**, which opposes the friction member **15**, refer to the retaining surfaces. Consequently, there is no need for securely attaching the friction members **15**, **16** to other members by means of an adhesive, and thus a cost is reduced. Further, the number of parts is reduced, which further reduces the cost. Still further, the sliding surfaces are determined to be between the lining plate **14** and the friction member **15**, and between the lining plate **14** and the friction member **16**, and thus a slipping torque generated at the limiter portion **2** is stabilized. Still further, no backlash occurs between the cover plate **11** and the friction member **16**, or between the pressure plate **13** and the friction member **15**. This reduces abrasions of the related members. Still further, the recesses **11**c, **13**c and the projections **11**d, **13**d are formed by the die punching performed on the cover plate **11** and on the pressure plate **13**, and thus variations of dimensions or positions of the recesses **11**c, **13**c and the projections **11**d, **13**d are reduced. Still further, the projections **11**d, **13**d formed on the cover plate **11** and the pressure plate **13** make the surfaces of the friction members **15**, **16** dented instead of piercing the friction members **15**, **16**. Then, the surfaces of the friction members **15**, **16** are pushed into the recesses **11**c, **13**c formed on the cover plate **11** and the pressure plate **13**. This prevents cracks from occurring on the friction members **15**, **16**, thereby retaining the friction members **15**, **16** in place while securing strength of the friction members **15**, **16**.

A second embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **3**A is a partial plane view schematically illustrating the structure of the retaining surface **11**b of the cover plate **11** and the retaining surface **13**b of the pressure plate **13** of the second embodiment. FIG. **3**B is a partial section view taken on line **3**B-**3**B illustrated in FIG. **3**A.

According to the second embodiment, which is a variation of the first embodiment, stepped projections **11**e, **13**e and stepped recesses **11**f, **13**f are additionally formed on the cover plate **11** and the pressure plate **13**. Other structures of the second embodiment are identical to those of the first embodiment, and thus explanations will be omitted.

The retaining surfaces **11**b, **13**b include the stepped projections **11**e, **13**e that project evenly from the flat surfaces (flat portions) of the retaining surfaces **11**b, **13**b so as to form table-like projections or shapes. The recesses **11**c, **13**c are formed at predetermined portions of the stepped projections **11**e, **13**e so as to be recessed, that is, dented, from respective surfaces of the stepped projections **11**e, **13**e. The projections **11**d, **13**d are formed around the peripheral edges of the recesses **11**c, **13**c so as to project, that is, to be raised, from the respective surfaces of the stepped projections **11**e, **13**e. The cover plate **11** and the pressure plate **13** also include the stepped recesses **11**f, **13**f, respectively. Specifically, the cover plate **11** includes the stepped recess **11**f at an opposite surface relative to the retaining surface **11**b, i.e., at one of the axial sides where the recess **11**c, the projection **11**d, and the stepped projection **11**e are not formed (which will be hereinafter referred to as an opposite surface of the retaining surface **11**b). In the same way, the pressure plate **13** includes the stepped recess **13**f at an opposite surface relative to the retaining surface **13**b, i.e., at one of the axial sides where the recess **13**c, the projection **13**d, and the stepped projection **13**e are not formed (which will be hereinafter referred to as an opposite surface of the retaining surface **13**b). The stepped recesses **11**f, **13**f, which are recessed or dented from flat surfaces (flat portions) of the opposite surfaces of the retaining surfaces **11**b, **13**b, axially face the stepped projections **11**e, **13**e respectively. The stepped projections **11**e, **13**e, the recesses **11**c, **13**c, the projections **11**d, **13**d, and the stepped recesses **11**f, **13**f are formed by first die punching on the retaining surfaces **11**b, **13**b and second die punching on the opposite surfaces of the retaining surfaces **11**b, **13**b of the cover plate **11** and the pressure plate **13**. Side walls of the stepped projections **11**e, **13**e, that is, circumferentially outer surfaces of the stepped projections **11**e, **13**e that are formed into the table-like shapes, are perpendicular to the flat portions of the retaining surfaces **11**b, **13**b. Each of the stepped projections **11**e, **13**e includes a predetermined pattern formed by the recesses **11**c, **13**c. Each of the stepped projections **11**e, **13**e includes four or more of the recesses **11**c, **13**c, desirably, for example, ten to thirty recesses **11**c, **13**c. A diameter of each of the step projections **11**e, **13**e is 20 millimeters or less. The retaining surfaces **11**b, **13**b include the multiple stepped projections **11**e, **13**e, desirably, for example, six or more of the stepped projections **11**e, **13**e. A height of each of the projections **11**d, **13**d from the surfaces of the stepped projections **11**e, **13**e is, desirably, for example, 0.01 millimeters or more. Each of the recesses **11**c, **13**c is shaped so that the center of the bottom thereof is the deepest and that the center of the bottom makes an angle of, desirably, for example, 120 degrees or less when viewed in the cross section (refer to FIG. **3**C).

According to the second embodiment, advantages similar to the first embodiment are attained.

A third embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **4**A is a partial plane view schematically illustrating the structure of the retaining surface **11**b of the cover plate **11** and the retaining surface **13**b of the pressure plate **13** of the third embodiment. FIG. **4**B is a partial section view taken on line **4**B-**4**B illustrated in FIG. **4**A.

According to the third embodiment, which is a variation of the first embodiment, through holes **11**g, **13**g are formed in the axial direction on the punched area of the retaining surfaces **11**b, **13**b respectively. Multiple convexes **11**h, **13**h are formed at each of the perimeters of the through holes **11**g, **13**g so as to project, that is, be raised, from the flat portions of the retaining surfaces **11**b, **13**b. Other structures of the third embodiment are identical to those of the first embodiment, and thus explanations will be omitted.

As shown in FIG. **4**A, the convexes **11**h, **13**h are arranged about the through holes **11**g, **13**g in a radial manner relative to the through holes **11**g, **13**g, and are formed so that a width of each of the convexes **11***h*, **13***h* is smaller at a portion away from the through holes **11***g*, **13***g* than at a portion closer to the through holes **11***g*, **13***g*, thereby representing a pointed radial end. As shown in FIG. **4**B, an axially extending portion of each of the convexes **11***h*, **13***h*, which axially extends from an inner wall of each of the through holes **11***g*, **13***g*, is formed to be perpendicular to the flat surface of each of the retaining surfaces **11***b*, **13***b*. In addition, a height of each of the convexes **11***h*, **13***h* is smaller at the portion away from the through holes **11***g*, **13***g* than at the portion closer to the through holes **11***g*, **13***g*. That is, the height of each of the convexes **11***h*, **13***h* in the axial direction of the pressure plate **13** and the width of each of the convexes **11***h*, **13***h* in a direction substantially perpendicular to the axial direction decreases in association with an increase of a radial distance from the through hole **11***g*, **13***g* so that each of the convexes **11***h*, **13***f* forms a sharpened edge. The convexes **11***h*, **13***h* and the through holes **11***g*, **13***g* may be formed by the first die punching on the retaining surfaces **11***b*, **13***b*, and the second die punching on the opposite surfaces of the retaining surfaces **11***b*, **13***b* of the cover plate **11** and the pressure plate **13**. The height of each of the convexes **11***h*, **13***h* is, desirably, for example, 0.01 millimeters or more from the flat portion of each of the retaining surfaces **11***b*, **13***b*.

According to the third embodiment, advantages similar to the first embodiment are attained.

A fourth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIGS. **5**A and **5**B are first and second partial plane views schematically illustrating the structure of the retaining surface **11***b* of the cover plate **11** and the retaining surface **13***b* of the pressure plate **13** of the fourth embodiment. FIG. **5**C is a partial section view illustrating the structure of the retaining surface **11***b* of the cover plate **11** and the retaining surface **13***b* of the pressure plate **13** of the fourth embodiment.

According to the fourth embodiment, which is a variation of the first embodiment, each of the retaining surfaces **11***b*, **13***b* of the cover plate **11** and the pressure plate **13** includes a knurled surface (that is, a surface having a pattern of raised-up areas and depressed areas). The knurling process is available in two types: a single type where a series of ridges are applied in one direction as shown in FIG. **5**A, and a cross type where a series of ridges are applied in two directions as shown in **5**B. The knurled surface has the pattern of the raised-up areas and the depressed areas, which are formed by alternate ridges and grooves. Other structures of the fourth embodiment are identical to those of the first embodiment, and thus explanations will be omitted.

According to the fourth embodiment, advantages similar to the first embodiment are attained. The advantages will be further enhanced by applying the cross-type knurling to the retaining surfaces **11***b*, **13***b* of the cover plate **11** and the pressure plate **13**.

A fifth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **6**A is a partial plane view schematically illustrating a structure of the friction members **15**, **16**. FIG. **6**B is a partial section view taken on line **6**B-**6**B illustrated in FIG. **6**A.

A fifth embodiment is a variation of the first embodiment. In the first embodiment, the surfaces of the friction members **15**, **16**, which oppose the retaining surfaces **13***b*, **11***b* of the pressure plate **13** and the cover plate **11** (refer to FIG. **1**) respectively, are formed into a flat shape. In the fifth embodiment, the surfaces of the friction members **15**, **16**, which oppose the retaining surfaces **13***b*, **11***b* of the pressure plate **13** and the cover plate **11**, have projection-recess shapes or concavo-convex shapes (plural grooves **15***b*, **16***b* are formed in the radial direction) to serve as retaining surfaces **15***a*, **16***a* (surfaces) of the friction members **15**, **16**. Consequently, the friction members **15**, **16** in contact with the retaining surfaces **13***b*, **11***b* restrict relative movements between the friction member **15** and the pressure plate **13** and between the friction member **16** and the cover plate **11** by means of the retaining surfaces **13***b*, **11***b* and the aforementioned projection-recess shapes (the concavo-convex shapes) of the surfaces of the friction members **15**, **16** opposing the retaining surfaces **13***b*, **11***b*. In case the friction members **15**, **16** include a hole or a recess, the grooves **15***b*, **16***b* are provided in positions where neither the hole nor the recess is formed so as to secure a thickness of the friction members **15**, **16**, thereby ensuring strength. The thickness of the friction members **15**, **16** at the portions where the grooves **15***b*, **16***b* are provided is, desirably, for example, 1 millimeter or more. It is also desirable that a width of each of the grooves **15***b*, **16***b* is 0.5 millimeters or more, a depth of each of the grooves **15***b*, **16***b* is 0.1 millimeters or more, and a distance between a circumferential sidewall of the grooves **15***b*, **16***b* and the circumferential sidewall of the adjacent grooves **15***b*, **16***b* is 20 millimeters or less. Slide surfaces **15***c*, **16***c* of the friction members **15**, **16** are formed to be flat. The friction members **15**, **16** include binding materials **15***e*, **16***e* (for example, rubber) that include therein fibrous base materials **15***d*, **16***d* (for example, glass fibers). On the retaining surfaces **15***a*, **16***a* (excluding the grooves **15***b*, **16***b*) of the friction members **15**, **16**, an exposure rate of the base materials **15***d*, **16***d* is 70 percent or less, desirably, for example, 50 percent or less, in order to improve a friction coefficient of the retaining surfaces **15***a*, **16***a*. Other structures of the fifth embodiment are identical to those of the first embodiment, and explanations will be omitted. In the fifth embodiment, the recesses **11***c*, **13***c* and the projections **11***d*, **13***d* that improve the frictional resistance may not be formed at the retaining surfaces **11***b*, **13***b* of the cover plate **11** and the pressure plate **13**, respectively. Further, the aforementioned configuration according to the fifth embodiment may be combined with the configuration of any of the first to fourth embodiments.

According to the fifth embodiment, advantages similar to the first embodiment are attained. In addition, the exposure rate of the binding materials **15***e*, **16***e* is increased (that is, the exposure rate of the base materials **15***d*, **16***d* is decreased) by providing the grooves **15***b*, **16***b* on the retaining surfaces **15***a*, **16***a* of the friction members **15**, **16**, and thus the friction coefficient of the retaining surfaces **15***a*, **16***a* is improved.

A sixth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **7** is a partial radial section view schematically illustrating the structure of the limiter portion **2**.

The sixth embodiment is a variation of the first embodiment. In the sixth embodiment, water, salt water, chemicals, or the like is applied entirely or partially to fixing surfaces **11***i*, **13***i* of the cover plate **11** and the pressure plate **13** respectively, before the pressure plate **13** and the cover plate **11** are assembled on the friction members **15**, **16**, and the like. Then, rust generated at the pressure plate **13** is used for fixing or retaining the friction member **15** to the fixing surface **13***i* of the pressure plate **13** while rust generated at the cover plate **11** is used for fixing or retaining the friction member **16** to the fixing surface **11***i* of the cover plate **11**. The rust at the fixing surfaces **13***i*, **11***i* penetrates through fibrous base materials of the friction members **15**, **16** so that the fixing surfaces **13***i*, **11***i* of the pressure plate **13** and the cover plate **11** are fixed to the friction members **15**, **16** respectively. Axial surfaces of the lining plate **14** in contact with the friction members **15**, **16** serve as slide surfaces **14***a*, **14***b* respectively. Other structures of the sixth embodiment are identical to the first embodiment, and explanations will be omitted.

According to the sixth embodiment, the axial surfaces of the lining plate **14**, which oppose the friction members **15**, **16** respectively, refer to the sliding surfaces, the axial surface of the cover plate **11**, which opposes the friction member **16**, refers to the fixing surface (i.e., the retaining surface), and the axial surface of the pressure plate **13**, which opposes the friction member **15**, refers to the fixing surface (the retaining surface). Consequently, there is no need for securely attaching the friction members **15**, **16** to other members by means of an adhesive, thereby reducing a cost. Further, the number of parts is reduced, which further reduces the cost. Still further, because the sliding surface is determined, a slipping torque generated at the limiter portion **2** is stabilized. Still further, no backlash occurs between the friction member **16** and the cover plate **11** at the fixing surface, or between the friction member **15** and the pressure plate **13** at the fixing surface. This reduces abrasions of the related members.

A seventh embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **8** is a partial radial section view schematically illustrating the structure of the limiter portion **2**. FIG. **9**A is a partial plane view schematically illustrating the structure of the retaining surface **11***b* of the cover plate **11** and the retaining surface **13***b* of the pressure plate **13** according to the seventh embodiment. FIG. **9**B is a partial section view taken on line **9**B-**9**B illustrated in FIG. **9**A. FIG. **9**C is an enlarged section view of an area Y illustrated in FIG. **9**B.

The seventh embodiment is a variation of the first embodiment. In the seventh embodiment, the recesses **11***c*, **13***c* and the projections **11***d*, **13***d* that improve the frictional resistance are not formed at the retaining surfaces **11***b*, **13***b* of the cover plate **11** and the pressure plate **13**, respectively. Instead, the friction members **15**, **16** include through holes (or recess portions or cut portions having bottoms) **15***g*, **16***g* respectively serving as first and second engagement portions. Then, a projection (which may be a pawl) **11***j* and a stepped recess **11***f* are provided at respective portions (specifically, respective axial sides) of the cover plate **11** so as to axially face the through hole **16***g* while a projection (which may be a pawl) **13***j* and a stepped recess **13***f* are provided at respective portions (specifically, respective axial sides) of the pressure plate **13** so as to axially face the through hole **15***g*. The projections **11***j*, **13***j* serving as first and second engagement projections engage with the through holes **16***g*, **15***g* respectively to thereby retain the friction member **15** by the pressure plate **13** in a relatively unrotatable manner and retain the friction member **16** by the cover plate **11** in a relatively unrotatable manner. Other structures of the seventh embodiment are identical to the first embodiment, and explanations will be omitted.

The cover plate **11** includes the projection **11***j* at the retaining surface **11***b* so as to engage with the through hole **16***g* of the friction member **16**. The projection **11***j* engages with the through hole **16***g* of the friction member **16** to thereby retain the friction member **16** in a relatively unrotatable manner. The cover plate **11** includes the stepped recess **11***f* at one of the axial sides where the projection **11***j* is not formed, i.e., the opposite surface of the retaining surface **11***b*, so that the stepped recess **11***f* axially faces the projection **11***j*. The projection **11***j* is formed by the first die punching relative to the retaining surface **11***b* while the stepped recess **11***f* is formed by the second die punching relative to the opposite surface of the retaining surface **11***b*. Each side wall of the projection **11***j* includes a vertical portion (vertical surface) **11***k* perpendicular to the flat portion of the retaining surface **11***b* as illustrated in FIG. **9**. A height of the vertical portion **11***k* is desirably specified to be equal to or greater than 30% of an overall height H of the projection **11***j* from the flat portion of the retaining surface **11***b*, for example. The overall height H of the projection **11***j* is desirably specified to be equal to or greater than 0.5 mm, for example. A planar shape of the projection **11***j* is a round shape, for example, having the diameter equal to or greater than 2 mm. Other structures of the cover plate **11** according to the seventh embodiment are identical to those of the first embodiment illustrated in FIG. **1**.

The pressure plate **13** includes the projection **13***j* at the retaining surface **13***b* so as to engage with the through hole **15***g* of the friction member **15**. The projection **13***j* engages with the through hole **15***g* of the friction member **15** to thereby retain the friction member **15** in a relatively unrotatable manner. The pressure plate **13** includes the stepped recess **13***f* at one of the axial sides where the projection **13***j* is not formed, i.e., the opposite surface of the retaining surface **13***b*, so that the stepped recess **13***f* axially faces the projection **13***j*. The projection **13***j* is formed by the first die punching relative to the retaining surface **13***b* while the stepped recess **13***f* is formed by the second die punching relative to the opposite surface of the retaining surface **13***b*. Each side wall of the projection **13***j* includes a vertical portion (vertical surface) **13***k* perpendicular to the flat portion of the retaining surface **13***b* as illustrated in FIG. **9**. A height of the vertical portion **13***k* is desirably specified to be equal to or greater than 30% of an overall height H of the projection **13***j* from the flat portion of the retaining surface **13***b*, for example. The overall height H of the projection **13***j* is desirably specified to be equal to or greater than 0.5 mm, for example. A planar shape of the projection **13***j* is a round shape, for example, having the diameter equal to or greater than 2 mm. Other structures of the pressure plate **13** according to the seventh embodiment are identical to those of the first embodiment illustrated in FIG. **1**.

The friction member **15** includes the multiple through holes **15***g* engaging with the respective projections **13***j* of the pressure plate **13**. The friction member **16** includes the multiple through holes **16***g* engaging with the respective projections **11***j* of the cover plate **11**. Other structures of the friction members **15**, **16** according to the seventh embodiment are identical to those of the first embodiment illustrated in FIG. **1**.

The aforementioned configuration according to the seventh embodiment may be combined with the configuration of any of the first to sixth embodiments.

An eighth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **10** is a partial radial section view schematically illustrating the structure of the limiter portion **2**. FIG. **11**A is a partial plane view schematically illustrating the structure of the retaining surface **11***b* of the cover plate **11** and the retaining surface **13***b* of the pressure plate **13** according to the eighth embodiment. FIG. **11**B is a partial section view taken on line **10**B-**10**B illustrated in FIG. **11**A. FIG. **10**C is an enlarged section view of an area Y illustrated in FIG. **11**B.

The eighth embodiment is a variation of the seventh embodiment. In the eighth embodiment, grooves **11***p*, **13***p* are formed at peripheral edges of respective base portions of the projections **11***j*, **13***j*. The projection **11***j* and the groove **11***p* are formed by the first die punching relative to the retaining surface **11***b* while the stepped recess **11***f* is formed by the second die punching relative to the opposite surface of the retaining surface **11***b*. In the same way, the projection **13***j* and the groove **13***p* are formed by the first die punching relative to the retaining surface **13***b* while the stepped recess **13***f* is formed by the second die punching relative to the opposite surface of the retaining surface **13***b*. Each side wall of the projection **11**_j_ includes the vertical portion **11**_k_ perpendicular to the flat portion of the retaining surface **11**_b_. Each side wall of the projection **13**_j_ includes the vertical portion **13**_k_ perpendicular to the flat portion of the retaining surface **13**_b_ as illustrated in FIG. **11**B. The height h of each of the vertical portions **11**_k_, **13**_k_ is desirably specified to be equal to or greater than 30% of the overall height H (i.e., the height from the flat portion of each of the retaining surfaces **11**_b_, **13**_b_) of each of the projections **11**_j_, **13**_j_, for example. The overall height H of each of the projections **11**_j_, **13**_j_ is desirably specified to be equal to or greater than 0.5 mm, for example. Other structures according to the seventh embodiment are identical to those of the first embodiment.

According to the eighth embodiment, advantages similar to the seventh embodiment are attained.

A ninth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **12**A is a partial radial section view schematically illustrating the structure of the limiter portion **2**. FIG. **12**B is a partial section view taken on line **12**B-**12**B illustrated in FIG. **12**A. In FIG. **12**B, the support plate **10** is omitted.

The ninth embodiment is a variation of the first embodiment. In the ninth embodiment, the recesses **11**_c_, **13**_c_ and the projections **11**_d_, **13**_d_ that improve the frictional resistance are not formed at the retaining surfaces **11**_b_, **13**_b_ of the cover plate **11** and the pressure plate **13**, respectively. Instead, the friction members **15**, **16** extend further outwardly and include cut portions (or holes) **15**_f_, **16**_f_ respectively serving as engagement cut portions. Then, the detent **13**_a_ of the pressure plate **13** engages with the cut portions **15**_f_, **16**_f_ so that the friction member **15** is retained by the pressure plate **13** in a relatively unrotatable manner while the friction member **16** is retained by the cover plate **11** in a relatively unrotatable manner. Other structures according to the ninth embodiment are identical to those of the first embodiment.

The aforementioned configuration according to the ninth embodiment may be combined with the configuration of any of the first to seventh embodiments.

According to the ninth embodiment, the detent **13**_a_ of the pressure plate **13** engages with the cut portions **15**_f_, **16**_f_ of the friction members **15**, **16** to thereby retain the friction member **15** by the pressure plate **13** and retain the friction member **16** by the cover plate **11**. Therefore, the axial surfaces of the lining plate **14**, which oppose the friction members **15**, **16** respectively, refer to the sliding surfaces, the axial surface of the cover plate **11**, which opposes the friction member **16**, refers to the retaining face, and the axial surface of the pressure plate **13**, which opposes the friction member **15**, refers to the retaining surface. Consequently, there is no need for securely attaching the friction members **15**, **16** to other members by means of an adhesive, thereby reducing a cost. Further, the number of parts is reduced, which further reduces the cost. Still further, because the sliding surface is determined, a slipping torque generated at the limiter portion **2** is stabilized.

A tenth embodiment of this disclosure will be explained with reference to illustrations of drawings as follows. FIG. **13**A is a partial radial section view schematically illustrating the structure of the limiter portion **2**. FIG. **13**B is a partial section view taken on line **13**B-**13**B illustrated in FIG. **13**A. In FIG. **13**B, the support plate **10** is omitted.

The tenth embodiment is a variation of the ninth embodiment. In the tenth embodiment, the friction members **15**, **16** are not retained in a relatively unrotatable manner by means of the detent **13**_a_ of the pressure plate **13** relative to the pressure plate **13** and the cover plate **11**. Instead, pawl portions **13**_m_, **11**_m_ are formed at the pressure plate **13** and the cover plate **11** respectively in a direction towards the lining plate **14**. The pawl portion **13**_m_ engages with the cut portion **15**_f_ of the friction member **15** and the pawl portion **11**_m_ engages with the cut portion **16**_f_ of the friction member **16** so that the friction members **15**, **16** are retained by the pressure plate **13** and the cover plate **11** respectively in a relatively unrotatable manner. As illustrated in FIG. **13**A, the pawl portion **13**_m_ is obtained by a bending of a portion of the pressure plate **13**. In the same way, the pawl portion **11**_m_ is obtained by a bending of a portion of the cover plate **11**. Voids of the cover plate **11** and the pressure plate **13** obtained by the bending of the respective portions of the cover plate **11** and the pressure plate **13** serve as window portions **11**_n_, **13**_n_ respectively. In FIGS. **13**A and **13**B, the pawl portions **11**_m_, **13**_m_, and the cut portions **15**_f_, **16**_f_ are provided in the vicinity of the outer circumferences of the friction members **15**, **16**. Alternatively, the pawl portions **11**_m_, **13**_m_, and the cut portions **15**_f_, **16**_f_ may be provided in the vicinity of intermediate portions or inner circumferences of the friction members **15**, **16**. Other structures of the tenth embodiment are identical to those of the seventh embodiment.

The aforementioned configuration according to the tenth embodiment may be combined with the configuration of any of the first to seventh embodiments.

According to the tenth embodiment, advantages similar to the ninth embodiment are attained.

The aforementioned first to tenth embodiments may be modified or adjusted in an appropriate manner.

According to the aforementioned first to tenth embodiments, an adhesive is not used to attach or fix the friction members **15**, **16** to the other member. Thus, a reduced cost and strength of each of the friction members **15**, **16** are both obtained. In addition, because of a reduction of the number of parts, further reduced cost may be achieved. Further, the sliding surfaces are determined to be between the lining plate **14** and the friction member **15**, and between the lining plate **14** and the friction member **16**, so that the slipping torque generated at the limiter portion **2** is stabilized. Furthermore, no backlash occurs between the cover plate **11** and the friction member **16**, or between the pressure plate **13** and the friction member **15**. This reduces abrasions of the related members.

According to the aforementioned third embodiment, the pressure plate **13** includes the through hole **13**_g_ at the retaining surface **13**_b_ and the multiple convexes **13**_h_ formed around the through hole **13**_g_ in a radial manner relative to the through hole **13**_g_, a height of each of the convexes **13**_h_ in an axial direction of the pressure plate **13** and a width of each of the convexes **13**_h_ in a direction perpendicular to the axial direction decreasing in association with an increase of a radial distance from the through hole **13**_g_ so that each of the convexes **13**_h_ forms a sharpened edge.

According to the aforementioned fifth embodiment, the retaining surface **15**_a_ of the friction member **15** facing the retaining surface **13**_b_ of the pressure plate **13** forms into a concavo-convex shape.

According to the fifth embodiment, the friction member **15** includes a hole or a recess at the retaining surface **15**_a_, and the grooves **15**_b_ are prevented from being formed at a portion of the friction member **15** where the hole or the recess is formed.

According to the fifth embodiment, the friction member **15** includes the fibrous base material **15**_d_ in the binding material **15**_e_ and the exposure rate of the base material **15**_d_ at the retaining surface **15**_a_ of the friction member **15** facing the retaining surface **13**_b_ of the pressure plate **13** is equal to or less than 70 percent.

According to the aforementioned seventh and eighth embodiments, the pressure plate **13** includes the projection

13*j* at the retaining surface **13***b* and the friction member **15** includes the through hole **15***g* engaging with the projection **13***j* of the pressure plate **13**.

According to the aforementioned first and second embodiments, the retaining surface **13***b* of the pressure plate **13** is entirely or partially formed by one of or both of the projections **13***d* and the recesses **13***c* for generating a slip resistance relative to the friction member **15**.

According to the first and second embodiments, the torque fluctuation absorbing apparatus **1** further includes the cover plate **11** arranged at the opposite side of the pressure plate **13** relative to the lining plate **14** and being rotatable relative to the lining plate **14**, and the friction member **16** disposed between the lining plate **14** and the cover plate **11** and pressed against the lining plate **14** in a slidable manner. The cover plate **11** includes the retaining surface **11***b* that makes contact with the friction member **16**. The retaining surface **11***b* is entirely or partially formed by one of or both of the projections **11***d* and the recesses **11***c* for generating a slip resistance relative to the friction member **16**.

According to the aforementioned first and second embodiments, the retaining surface **13***b* includes the recess **13***c* of which the height is lower than the height of the flat portion (flat surface) of the retaining surface **13***b* and includes the projection **13***d* at a peripheral edge of the recess **13***c*. The height of the projection **13***d* is higher than the height of the flat portion of the retaining surface **13***b*.

According to the second embodiment, the retaining surface **13***b* includes the stepped projection **13***e* evenly projecting from the flat portion of the retaining surface **13***b*, the recess **13***c* formed at a portion of the stepped projection **13***e*, the height of the recess **13***c* being lower than the height of the surface of the stepped projection **13***e*, and the projection **13***d* formed at a peripheral edge of the recess **13***c*, the height of the projection **13***e* being higher than the height of the surface of the stepped projection **13***e*. The pressure plate **13** includes the stepped recess **13***f* at the opposite surface relative to the retaining surface **13***b*, the retaining surface **13***b* and the opposite surface being formed at the axial side surfaces of the pressure plate **13** respectively, the stepped recess **13***f* axially facing the stepped projection **13***e* and being recessed greater than the flat portion of the opposite surface of the pressure plate **13**.

According to the first embodiment, the recess **13***c* and the projection **13***d* are formed by die punching relative to the retaining surface **13***b*, and a plurality of combinations of the recess **13***c* and the projection **13***d* is formed at an area obtained by the die punching one time relative to the retaining surface **13***b*.

According to the second embodiment, the stepped projection **13***e*, the recess **13***c*, the projection **13***d*, and the stepped recess **13***f* are formed by the first die punching relative to the retaining surface **13***b* and by the second die punching relative to the opposite surface relative to the retaining surface **13***b*. A plurality of combinations of the recess **13***c* and the projection **13***d* is formed at the portion of the stepped projection **13***e*.

According to the aforementioned seventh embodiment, the projection **13***j* includes the side wall having the vertical surface **13***k* perpendicular to the flat portion of the retaining surface **13***b* of the pressure plate **13**.

According to the seventh embodiment, the cover plate **11** includes the projection **11***j* at the retaining surface **11***b* and the friction member **16** includes the through hole **16***g* engaging with the projection **11***j* of the cover plate **11**.

According to the aforementioned ninth embodiment, the cover plate **11** includes the hole **11***a*, and the pressure plate **13** includes the detent **13***a* inserted into the hole **11***a* of the cover plate **11** in a relatively unrotatable manner and an axially movable manner. The friction members **15**, **16** include respective cut portions **15***f*, **16***f* engaging with the detent **13***a* of the pressure plate **13**.

The torque fluctuation absorbing apparatus **1** further includes the cover plate **11** arranged at the opposite side of the pressure plate **13** relative to the lining plate **14** and being rotatable relative to the lining plate **14**, and the friction member **16** disposed between the lining plate **14** and the cover plate **11** and pressed against the lining plate **14** in a slidable manner. The cover plate **11** includes the projection **11***j* at the retaining surface **11***b* and the friction member **16** includes the through hole **15***g* engaging with the projection **11***j* of the cover plate **11**.

According to the aforementioned fourth embodiment, each of the retaining surfaces **11***b*, **13***b* includes a knurled surface having a pattern of raised-up areas and depressed areas.

According to the aforementioned seventh embodiment, the height of the vertical surfaces **11***k*, **13***k* is specified to be equal to or greater than 30% of the overall height H of the projections **11***j*, **13***j* from the flat portion of the retaining surfaces **11***b*, **13***b*.

According to the sixth embodiment, the torque fluctuation absorbing apparatus **1** includes the lining plate **14**, the pressure plate **13** rotatable relative to the lining plate **14**, the friction member **15** disposed between the lining plate **14** and the pressure plate **13** and making contact with the lining plate **14** in a pressing manner and a slidable manner, the pressure plate **13** including the retaining surface **13***b* that makes contact with the friction member **15**, the friction member **15** being fixed to the retaining surface **13***b* by a rust generated entirely or partially at the retaining surface **13***b*.

The principles, preferred embodiment and mode of operation of the present invention have been described in the foregoing specification. However, the invention which is intended to be protected is not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. Variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present invention. Accordingly, it is expressly intended that all such variations, changes and equivalents which fall within the spirit and scope of the present invention as defined in the claims, be embraced thereby.

The invention claimed is:

1. A torque fluctuation absorbing apparatus comprising:

a first plate member;

a second plate member rotatable relative to the first plate member; and

a first friction member disposed between the first plate member and the second plate member and pressed against the first plate member in a slidable manner;

the second plate member including a first engagement projection which is integral with the second plate member and is provided at a first retaining surface of the second plate member to project from the first retaining surface,

the first friction member including a first engagement portion formed into either a hole shape, a recess shape, or a cut shape at a surface facing the second plate member, the first engagement portion engaging with the first engagement projection of the second plate member.

2. The torque fluctuation absorbing apparatus according to claim **1**, wherein the first engagement projection includes a side wall having a vertical surface perpendicular to a flat portion of the first retaining surface of the second plate member.

3. The torque fluctuation absorbing apparatus according to claim **1**, further comprising a third plate member arranged at an opposite side of the second plate member relative to the first plate member and being rotatable relative to the first plate member, and a second friction member disposed between the first plate member and the third plate member and pressed against the first plate member in a slidable manner, wherein the third plate member includes a second engagement projection at a second retaining surface and the second friction member includes a second engagement portion formed into either a hole shape, a recess shape, or a cut shape engaging with the second engagement projection of the third plate member.

4. The torque fluctuation absorbing apparatus according to claim **1**, wherein the first engagement portion of the second plate member is formed by die punching relative to the first retaining surface.

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